

A SYSTEMS APPROACH TO DELIVERING NET ZERO: RECOMMENDATIONS FROM THE PRIME MINISTER'S COUNCIL FOR SCIENCE AND TECHNOLOGY

How might the Government use a disciplined and rigorous whole systems approach to deliver a better transition towards the net-zero emissions target?

Foreword

1. In seeking to deliver net-zero emissions by 2050, the UK starts from a position of advantage. The Climate Change Act provides the legal framework for decarbonisation, with the independent Committee on Climate Change setting out the legally-binding Carbon Budgets required to meet the government's emissions reduction target. The new legal commitment to net zero by 2050 represents a significant step change in the UK's level of ambition. Putting this on a statutory basis is good, but without an *equally strong and effective structure inside government* the legal commitment alone will not drive the required transformation of our economy and society.
2. CST has drawn on science and engineering expertise to offer advice on how a *whole systems approach* can provide the framework that government requires to lead change across public and private sectors. Our recommendations seek to:
 - *Strengthen the institutions, governance frameworks and leadership structures of central government to galvanise action*
 - *Develop the analytical capability, flow of information, and reporting needed to inform decisions*
 - *Maximise the contribution of technology, mobilise financial systems and galvanise international collaboration*
3. By drawing on systems engineering principles, a detailed and credible plan can provide the framework required to drive change, give reassurance to businesses, investors and consumers and engage the whole of society in delivering this change. It will show us how to build on the UK's fundamental strengths in research and innovation and ensure that the government maintains oversight of progress, testing and adjusting policies as necessary.

SECTION A: WHAT IS A WHOLE SYSTEMS APPROACH?

4. A whole systems approach enables decision makers to understand the complex challenges posed by the net-zero target and devise solutions and innovations that are more likely to succeed. It is a discovery process combining structured approaches to understanding and managing physical factors (such as infrastructure and novel/advanced technologies) with broader perspectives on economic, behavioural and other issues, taking into account complex interactions. This systemic approach helps manage the associated uncertainties, including technical and behavioural factors, and requires the use of both quantitative and qualitative approaches, including systems engineering.
5. Using this approach allows policymakers to consider behaviours and interactions between different parts of the system, and how these can combine to affect an outcome¹. Policymakers can better understand the interrelated nature of the sectors, technologies, behaviours and policies and realise the scale of cumulative, connected changes that are needed to achieve net zero. This approach will enable the government to:
 - Identify elements or pressures in the system which are working against the overall goal along with points of greatest leverage where interventions will make most difference;
 - Reveal important synergies and interdependencies between different decarbonisation strategies and different policy priorities, help balance trade-offs and realise opportunities for additional benefits such as improved health outcomes;
 - Help account for social, cultural and behavioural factors that can act as both barriers to and levers for change;
 - Understand time pressures and sequencing, determining when there is a window of opportunity to intervene and what information is required to inform those decisions;
 - Identify risks and mitigation strategies to reduce the impact of unintended consequences;
 - Develop adaptive approaches to manage future uncertainty and target real-time assessment and monitoring;
 - Demonstrate the scale of the transition challenge; and
 - Monitor effects and adapt responses over time.
6. Achieving net zero by 2050 is a system transformation challenge. A clearer understanding of the entirety of the system will enable the identification of multiple intervention points required to achieve this goal. Policy areas that have previously been managed separately or in isolation will need to be brought together. They should be developed as an interconnected programme of work, driven by data and analytics, with responsibilities, funding and accountability aligned behind a single goal.

¹ Thinking in systems: a primer. Meadows, 2009.

SECTION B: RECOMMENDATIONS

PART 1: Strengthen the institutions, governance frameworks and leadership structures needed across central government to galvanise action to achieve net zero.

7. Achieving the target of net-zero emissions in the UK is only credible if policy action ramps up significantly. This will require urgent progress on delivery and strong leadership at the heart of government. We welcome the creation of the new Cabinet Committee on Climate Change and that this will be chaired by the Prime Minister. We propose three recommendations below to strengthen the governance framework for delivering net zero, illustrated in **Annex A**.

Recommendation 1: The newly established Cabinet Committee on Climate Change should ensure the net-zero target is translated into all areas of government responsibility. This is essential to guide the development of specific actions needed in the coming years to achieve net zero by 2050. Strong leadership from the Committee is essential to maintain a sense of urgency and accountability.

8. We recommend the Committee should have the following functions:

Function 1 – provide leadership by building a clear vision of the system required to achieve net zero.

9. A clear vision is required to align public and private investment and ensure that individual decisions, whether taken by government, businesses or individual citizens are aligned with the goal. Setting this vision would allow development of clear timescales for decision points, set a framework for working in partnership with industry for delivering the infrastructure changes, and help avoid unnecessary expenditure and delay. It would promote better public understanding and give industry and investors the clarity and reassurance required to progress towards net zero with confidence.
10. Without a clear long-term vision there is a risk that investment in infrastructure (both new build and transformation of existing infrastructure), from housing, transport networks and energy generation and distribution, will not join up into a coherent and efficient zero-carbon system fit for the future, creating a barrier to achieving net zero.
11. The success of Function 1 will be dependent on all the following functions also being implemented.

Function 2 – identify and explore system-level issues, including synergies and trade-offs between different departmental responsibilities, the sequencing of changes in different sectors.

12. The Committee must be able to explore synergies between achieving net zero and other national objectives, such as economic growth, health, national security and resilience. Systemic transformation on the scale necessary will involve a range of policies, taxes, regulation, standards, financial instruments, research and innovation, city design and land-use management. The coherence of such policies across activity and over time would be a key task for the group.
13. Adopting a whole-system approach to decarbonisation will identify risks, opportunities and adaptations otherwise missed and allow their mitigation or exploitation. Consideration of the path dependencies, deployment sequencing, and the best levers for influence is critical to this function.
14. We envisage the Government will need to take a flexible, experimental and iterative approach to policy making and implementation, anticipating failures and unintended consequences. Plans should be developed so that they can be adapted in response to changing future needs. There should be a strong focus on maintaining awareness of progress and ‘course correction’ through dynamic monitoring and evaluation.

Function 3 – authority to negotiate across competing priorities and drive through difficult decisions.

15. The Committee must have the authority to broker a unified strategy between different departments, between different levels of government and between different sectors, all of whom may have conflicting requirements, goals and timescales for delivery.
16. It must also be able to intervene in policy areas which threaten the delivery of a decarbonised system and explore the impact that its policies may have in other policy areas, such as health, biodiversity and the circular economy.
17. The Committee will want to take account of public views on the consequences and trade-offs between potential actions to achieve net zero, including consideration of the principle of a ‘just transition’.
18. We welcome plans for Citizens Assemblies commissioned by the House of Commons Select Committees to explore pathways for action on climate change.

Function 4 – identify where decisions and responsibility for action should be devolved to others, including devolved administrations, metropolitan and local authorities, business and community groups.

19. The Ministerial leadership group will need to recognise and empower decentralised approaches to decision making and implementation, engaging a wide range of actors at all levels of government across the UK through alignment with the overarching net zero vision and access to whole systems data.
20. Climate change mitigation policy is devolved under the Climate Change Act 2008, including for greenhouse gas reduction targets. As well as considering the further devolution of powers to deliver decarbonisation in Scotland, Wales and Northern Ireland there is significant opportunity for further delegation of decision-making powers to regions and local authorities in England to enable development of local decarbonisation plans.
21. Oversight of a whole systems map that includes multi-level components will ensure coherence between national, regional and local plans. All players must have visibility of key decisions and timelines, have the ability to access and understand systems level data and be able to act on it to drive change. The lack of capacity and capability in local authorities should be addressed as well as consideration of devolution of powers to raise money locally for decarbonisation measures. Local government will have an important role to play in empowering community groups and engaging individual citizens, who will need support to decide what net zero means for them.
22. Encouraging leadership and decentralised action at a local level will also be an opportunity to pilot or provide a testbed for decarbonisation initiatives. The government should ensure evidence on ‘what works’ is brought together and shared widely. Testing of different approaches will need to run in parallel.
23. However, the leadership group should make clear which decisions and actions will need to be taken at national level, such as:
 - a. taxation in construction, buildings and clean technologies, such as the level of VAT and business rates on the technologies and practices needed to reach net zero;
 - b. transport incentives e.g. fuel duty, grants or loans for electric vehicles;
 - c. action to decarbonise heat, including whether to switch the gas grid to hydrogen or move to electrified heat;
 - d. carbon capture, utilisation and storage on energy generation and industrial emissions
 - e. how to accommodate net- zero ambitions within trade policies and wider international negotiations
24. The leadership group must also understand the impact of net zero on “place” across the UK, which will be an important lens through which to consider

alternative pathways and the implications of action on net zero. There will be opportunities to reinvigorate local economies in some areas as industry is decarbonised and different natural resources become increasingly important. Government has a responsibility to consider and manage the impacts in areas where existing industries will be disrupted.

Recommendation 2: The Cabinet Secretary should establish a multi-disciplinary operational group to support the development of the strategy and drive delivery across government.

25. We note that the Cabinet Committee will require significant civil service underpinning and innovation in the systems and processes of government to be successful, including the creation of a cross-departmental delivery unit responsible for overseeing and co-ordinating progress towards net zero.
26. We welcome the establishment of the Climate National Strategy Implementation Group (NSIG) and the Cabinet Secretary's leadership to encourage new approaches for coordinating civil service activity across departmental boundaries. Further evolution of governance infrastructures will be needed to ensure the necessary level of funding and accountability for the net-zero target.
27. The operational group will require high level leadership and have significant delegated authority. It will need strong skills for adaptive, iterative policy making, including commissioning and using evidence. We would expect it to include or draw on policy experts, systems experts (including expert systems engineers), technical experts, project managers and operational leaders, and behavioural scientists. It will require strong integrative leadership.

Recommendation 3: Government should develop a stronger, better integrated analytical hub to:

- a) provide Ministers and the operational group with a broader understanding of systems and the interactions between technical, economic, environmental and social factors relevant to achieving net zero.
- b) publish and share evidence and models and leverage the host of actors who wish to collaborate on this endeavour, making data available to inform decisions taken at a regional or local level.

28. Ministers need sufficient understanding of the whole system so that they can make effective decisions about the speed and scale of change needed. There is an urgent need to better understand the specific timescales and activities required over the next decade and identify critical actions and policy interventions required in the near future. Government must negotiate a path

between taking early decisions to reduce uncertainty and focus action and leaving flexibility to allow diverse, innovative, experimental approaches.

29. To inform this, we propose establishing an enhanced government-wide analytical hub, with the authority to work across government and reach out to experts in business and academia outside government to gather data, analyse and communicate insight to leaders.
30. The hub should ensure that departments are drawing on world-class expertise across a range of disciplines to understand the available technologies relevant to decarbonisation and their prospects for deployment, from scientists, engineers, economists and financiers to behavioural and social scientists. It should be a central repository for technology roadmaps to ensure key uncertainties and assumptions are transparent and a plan is in place to address them.
31. This team should also be a focal point for expertise in using analytical techniques (such as systems thinking approaches, data science, AI and computational modelling, deliberative approaches, scenario planning and tools such as data visualisation or digital twinning). It should also provide access to knowledge, data and know-how for decision-makers in local and devolved governments.
32. The analytical hub should play a leading role in developing modelling capability across government, building on existing strengths in BEIS and other Departments (**Annex B**). A key challenge is to integrate insights from across government to collate a coherent and sufficiently granular overview of the whole system, including understanding the impacts of interventions in different areas of the UK and across time. Cross-sector synthesis of analysis and insight can identify critical areas for action and provide insight on system-wide costs of “doing nothing” and alternative policy options. The hub should develop a set of high-level tools that allows senior policy makers to understand the timelines and trade-offs relating to various pathways towards net zero.
33. Transparency and flow of data to inform analysis is essential to maintain quality and robustness of the analysis. We recommend that all data to inform this analysis should be open and accessible. All publicly funded models used in policy development should be open-source and available to all. Where privately held models are used in UK public policy, these should be at least open description and ideally open access².
34. The analytical hub should ensure that data is used to support decision-making at all levels. It should work with devolved administrations and local authorities to ensure they have access to up-to-date and sufficiently granular data to develop decarbonisation programmes. Data from private sector providers of low-carbon

² open description (has documentation); open access (access via paying [perhaps for software] or contributing to its development); open source (truly open to use for anyone wishing to pick it up)

solutions will be important, including effective use of smart meter data, and Government should work with business and regulators to ensure access to data to inform local plans.

35. The hub should play a leading role in driving policy innovation through the use of experiments to gain insights into what works in a UK or local context, working with local authorities and others to enable this. Learning from local, regional and international experiences will be an important element for the analytical hub to encourage.

PART 2: Develop the analytical capability, flow of information, and reporting needed to inform decisions

Recommendation 4: Government should require all regulators to develop an explicit first-order objective to support the transition to net zero by 2050.

36. Our regulatory framework needs to be aligned to net zero. Climate change has long term implications for health, the environment and the economy. Regulators have responsibilities to safeguard public safety and environmental standards as part of their role and this is consistent with an explicit responsibility to support the transition to net zero. This should extend to all regulators and standards bodies (including but not limited to Ofgem, the Financial Conducts Authority, Office of Road and Rail, Civil Aviation Authority and Competition and Markets Authority).
37. Through the Better Regulation Executive, Government should bring together regulators and standards bodies to ensure a shared vision of regulatory alignment for net-zero and approach to trade-offs with other priorities such as managing water quality, energy security, safe operation and protecting the immediate interests of consumers.
38. Regulation and standards in all sectors must be agile and responsive to enable companies to capitalise on the opportunities from emerging technologies relevant to net zero. A flexible and responsive approach to regulation should be implemented to help speed innovation trajectories. The goal should be that (i) all regulatory systems are proportionate and adaptive to the needs of relevant innovations; and (ii) no net zero-relevant innovation is unnecessarily delayed in its development trajectory by the lack of an appropriate regulatory system.
39. The next phase of decarbonisation in the UK will require very different solutions in different areas; how a rural area decarbonises is very different to how a city might. There is a potentially important role for the introduction of local area energy planning to help navigate the appropriate pathways for different local areas, in a consistent and comparable way. This could also help inform future network investment, as well as helping build democratic consensus for action.

Reform of the planning system and the strengthening of building regulations announced by the Government in October 2019 are major opportunities to enable low-carbon infrastructure development. This would help reduce the currently long deployment timelines for new approaches.

40. Investment and innovation require confidence in the investment climate. Climate policy risk deters investment. This means the government should be clear and predictable in the criteria it will use to guide future change as technologies develop, diffusion takes place and experience develops.

Recommendation 5: To enable transparency and accountability across government, we recommend that government undertake and publish carbon emissions assessments for all public sector policies, including major infrastructure projects or investments.

41. An assessment of implications for carbon emissions needs to be embedded into government policy decisions, procurement frameworks and investment decisions.
42. Decision-making must factor in the reduction of consumption emissions and avoid incentives to offshore. For example, the UK has very high energy network and generation costs that are passed on to businesses and this is harming UK production in favour of often coal fired energy elsewhere e.g. ceramics. We need new ways of accounting for consumption emissions robustly so we can achieve an internationally just transition.
43. Unintended offshoring of emissions or shifting of impacts to the detriment of other sustainability imperatives can potentially be identified, and therefore mitigated, through the use of sustainability assessment tools like life-cycle assessment which can be used to systemically analyse the sustainability impacts of policies, processes and products.
44. The Treasury Green Book requires a carbon assessment for major investments (such as transport infrastructure). This is used to make a judgement as to whether the project is affordable, in line with other objectives and value for money. However, this requirement does not appear to be consistently applied as a first order consideration in decision making across a broader spectrum of strategic policies, including those not overtly related to climate change. The Treasury is well placed to lead work across government to consider how carbon impacts are more systematically assessed. New guidance may be needed to handle technical uncertainty for projects with long timescales, enabling mitigation, adaptation and resilience to be rigorously and consistently considered.

45. Government procurement and estates activity must also align to net-zero requirements. This could lead to action to help stimulate the market for low-carbon technologies. Public works constitute a significant portion of the construction industry in the UK and public infrastructure now outstrips new work on private infrastructure³.
46. As a first step towards informing the next National Infrastructure Assessment (NIA), we suggest the National Infrastructure Commission (NIC) should focus on a whole systems approach to advise on how the UK's future infrastructure will be compatible with net zero. This should consider the synergies and interdependencies between technologies and sectors.

PART 3: Maximise the contribution of technology, mobilise financial systems and galvanise international collaboration

47. We cannot rely on the development of new breakthrough technologies to deliver our net-zero ambitions. But development and deployment at scale of emerging and mature technologies in the next thirty years will not on their own deliver net zero without also requiring both large changes to lifestyle (dietary choices, flying) and a more consistent approach to ensuring markets appropriately value decarbonisation.
48. The impacts of these changes on the economy and society are not clear and our recommendation is to pursue both mature technology implementation and enhancement together with more rapid pull through of emergent technologies.
49. A range of policy instruments is needed to accelerate deployment of innovative technologies for decarbonisation:
- a. **Institutional and market mechanisms** (such as carbon pricing, regulation, planning) to encourage technologies and the development of cost-effective approaches to decarbonisation.
 - b. Strategy for public private partnership to ensure **investment in infrastructure** development at the required scale (e.g. upgrade to electricity distribution network capacity) and financial levers to allow individuals, businesses and local authorities to invest in decarbonisation.
 - c. A bold, coherent, mission-driven **programme of public sector R&D investment**, coordinated and co-designed with industry to support and de-risk technology development, initial deployment and scale-up.
50. Fast tracking carbon reduction requires *a triple track approach*: deploying at scale those technologies that are ready, develop those that are not and research solutions to problems of decarbonisation that we cannot yet solve. All three

³<https://www.ons.gov.uk/businessindustryandtrade/constructionindustry/articles/constructionstatistics/2018#structure-of-the-industry>

activities need to take place in parallel and in a coordinated fashion, supported by public sector R&D spend.

51. Government will need to bring together world class experts to advise on which technologies are ready for deployment or development, the likely carbon reductions and costs as well as which technologies to research.
52. Government should explore urgently 'no-regrets' actions that will enable existing technologies to be tested at scale. This should build on the net-zero pathways work of the Committee on Climate Change. These might include developing zero carbon energy vectors, such as hydrogen, green ammonia and carbon capture usage and storage (CCUS) but would need careful planning to anticipate and monitor interdependencies and mitigate adverse impacts.

Recommendation 6: Government should bring together public sector funders to develop a bold, coherent, mission-driven programme of public sector research and innovation investment to achieve net zero. This body should have a level of authority to influence spending decisions across departments, influence the strategic direction of UKRI programmes and set out opportunities for leveraging business activity.

53. We recommend that the body should deliver the following functions:

Function 1 – develop living technology roadmaps to set out which technologies are truly ready to deploy and how effectively they will reduce carbon emissions.

- a. The body should draw on systems analysis to understand the timelines required for technology development, working back from 2050 to understand the latest decision points for choosing a particular pathway, and identifying the corresponding research, development and deployment (RD&D) needs to make those decisions.
- b. This would provide a powerful insight to inform the research and innovation strategy and the overall vision for achieving net zero.
- c. The body should use the living technology roadmaps to bring together and align spending from relevant public funders and institutes (including departments, UKRI, Ofgem, British Business Bank and the Green Finance Institute). This will ensure a coherent strategic approach and connectivity across the whole RD&D landscape. It will ensure that results of research are pulled through to development and deployment more effectively.

Function 2 – continuously evaluate the technology roadmaps to assess progress in research, development and deployment needs and act on

this information to modify, amplify or reverse the trajectory of technological development.

- d. Continuous monitoring and evaluation will ensure that the effects of new technologies, both positive and negative, are identified as they are deployed and acted on. This might include understanding the consequences for other policy areas, including any shift in the burden of decarbonisation.
- e. There must be a willingness to remove support and prevent deployment of technologies when impacts turn-out to be unexpectedly detrimental. This must be communicated clearly if we are to retain confidence in the market.
- f. The body should consider the use of trials and experimentation to understand user behaviours and responses to technologies, developing an understanding of what works, particularly as the use of decentralised and digitalised technology changes the energy system. The Energy Systems Catapult's (ESC's) Living Lab⁴, the Behavioural Insights Team (BIT), ESRC⁵ and the Centre for Acceleration of Social Technology (CAST) should be drawn on to build consumer insight, trialling and design-focus into policymaking. Living Labs and Demonstrators should be used to integrate research and innovation processes in real life communities and settings.

Function 3 – encouraging innovation investment from business and third sector funders

- g. By setting a clear direction for public-funding and developing open and accessible technology roadmaps, the body should stimulate private sector R&D investment. To support this, the body should ensure that there is effective private sector representation and engagement to shape the development and deployment of green innovation at scale and across a wide range of sectors. Given its role in providing public and market leadership on green finance, the Green Finance Institute will be an important partner in this endeavour.

54. The current Energy Innovation Board provides a good foundation for development of a coordinated strategy to address research and innovation needs. The Board could expand its remit to focus more clearly on achieving the net-zero target.

⁴ <http://www.peoplelab.energy/>

⁵ <https://esrc.ukri.org/news-events-and-publications/news/news-items/esrc-funds-new-5-million-climate-change-research-centre/>

Recommendation 7: To further support deployment of decarbonisation technology and infrastructure, the government should consider **establishing a national infrastructure investment bank**, with an explicit mandate to **support the transition to net zero**, to help manage risk, partner with the private sector, and bring down the cost of finance.

55. The large-scale investment required for the move to low-carbon infrastructure, and associated early-stage risk, is not served well by the private sector on its own.

56. A national infrastructure investment bank will be able to crowd-in private finance through helping to carry the large-scale economic and political risks which can be a feature of infrastructure investment, particularly in the early stages. It will lower the costs of capital for decarbonisation initiatives, securing large-scale investments required for the transition to low-carbon infrastructure.

57. This will be of special importance in getting the pace and scale of change needed in infrastructure to achieve net zero, particularly given loss of access to the European Investment Bank.

58. If done well, the partnerships that are enabled with the private sector can be powerful multipliers (both at the time of initial investment and at later stages). Internationally there are examples with the European Bank for Reconstruction and Development (EBRD), European Investment Bank (EIB), the International Finance Corporation (IFC), the inter-American Development Bank (IADB) and the Asian Infrastructure Investment Bank (AIIB).

59. Such a bank would require independence from government in its operations, clear operating principles and transparency. It would need to build and draw upon relevant skills across investment banking and investment markets and should be able to lend to lower tiers of government.

Recommendation 8: To help households, businesses and public service providers make the investments needed to deliver the transition to net zero, the government should work with private sector financial institutions to establish frameworks and instruments to give them access to the required finance and support.

60. Consumer- and industry-led approaches will be essential to deliver the transition to net zero at the pace and scale needed, but many individuals and companies

will need help to understand what such a transition could mean for them. For each sector, Government should consider what support would be appropriate to overcome upfront costs of transition.

61. Where the right financial incentives are put in place to reduce emissions, the efficient, timely and effective availability of finance in a simple, low-cost form is a crucial element of a package that can enable change at the level of the household and small firm. HMT should work with responsible departments to address situations where this is not provided by the market, either through wider efforts to improve access to finance or specific climate-related interventions.
62. In some cases, the provision of finance on better terms will not be sufficient to enable the rapid change necessary and influence the behaviour change required, and simpler approaches financed by grants or regulation will be more effective and efficient. A systems approach would also help identify where wider public policy levers (including those supporting small business finance or social housing) can be made to work better in support of net zero.
63. This should include piloting the deployment of technologies at scale to bring down costs and refine understanding of what works. A strong candidate would be whole-house deep retrofit where the current system of Energy Company Obligations for lower income households and private finance -led reincarnation of the Green Deal is not delivering the pace of transformation needed.
64. We welcome the work in HMT's Net Zero Review⁶ considering whether financial incentives, alongside regulations and direct support, can be used to deliver a 'just transition' where those on lower incomes do not disproportionately bear the costs (either through taxation or bills).
65. The involvement of the energy supply companies, including Distribution Network Operator (DNO) to a Distribution System Operator (DSO), will be critical. It would be helpful for government to also consider whether UK pension funds could be encouraged or required to invest in net zero technologies and infrastructure.

Recommendation 9: Government should announce a clear, credible domestic plan for achieving net zero to set an example that could help inspire international action and commitment under presidency of the COP26 in Glasgow. It should build the objective of fostering international action into its work and international collaborations on trade, investment, finance, technology, capacity building and R&D.

⁶ <https://www.gov.uk/government/news/net-zero-review-launched-to-support-uks-world-leading-climate-commitment>

66. The UK produces less than 1% of global emissions but our global networks and track record in decarbonisation, including the establishment of legally binding targets for carbon emissions gives the UK a unique position to influence and amplify action worldwide.
67. Our commitment to overseas development funding and strength in international scientific collaboration provide further credibility and the ability to take effective action. The UK can lead progress on technology and finance, which could greatly strengthen the pace and substance of international climate agreements.
68. Our advice focusses on achieving the domestic target of net zero by 2050, but it is of vital importance that the UK makes its international influence as effective as possible, without which domestic actions cannot have a desired global effect. This will be key to the UK redefining its role as a 'Global Britain'.
69. Having a clear and credible domestic plan for delivering net zero by 2050 will set the scene for an inspiring and influential presidency of the COP26 in Glasgow. The UK can influence the rest of the world, both richer and poorer countries, by showing how a rapid transition can be managed well and by minimising its costs – lessons learned in the UK must be shared with others. The COP26 planning teams should have as a priority the sharing of ideas internationally and allocate resources to do this.
70. Government should seek to lower the barriers to international collaboration, identify how technology strengths in others can support delivery of UK net zero and how to speed up the global deployment of net-zero solutions. The Energy Innovation Board or related body should draw on the best available international expertise, science and technology to support development of technology roadmaps.
71. Lowering barriers to international collaboration in support of discovery, development and deployment of net-zero solutions can be expected to lower the costs of the global transition to net-zero transition, including costs to the UK. We can expect to see benefits from strengthened supply chains, an expansion of trade, societal and cultural changes that reduce carbon emissions and support development of more stable and sustainable use of energy and resources. The UK should actively promote the co-benefits that can be achieved by considering mitigation, adaptation and other beneficial outcomes (such as health, biodiversity) in a joined-up manner.
72. A key challenge is to improve the sharing of net-zero innovation, with a fairer distribution of costs and benefits. The government should leverage the depth and breadth of UK capability and global influence in order to:
 - a. Understand the comparative technology strengths of the UK and overseas partners in order to support discovery, development and deployment of fit-

for-purpose net-zero solutions both in the UK and overseas. R&D must be closely linked to needs and end-users.

- b. Identify and reduce barriers to development of efficient global supply chains to support discovery, development and deployment of net-zero solutions. This may include removing trade barriers, agreeing mechanisms to share IP with developing countries or provision of trade finance and guarantees to support market development.
- c. Use ODA funding to build overseas capacity to engage with the UK research and innovation base and support effective utilisation and uptake of net-zero solutions.
- d. Use its membership of international financial institutions, the UN organisations and international organisations more generally to keep action on climate change and the drive to net zero amongst their top priorities.
- e. Strengthen the ability of the overseas network to support global delivery of net zero, bringing together relevant DfID, FCO, BEIS and DIT capability under clear leadership.

Looking to the future (adaptation)

73. Regardless of how successful we are with our domestic ambitions to achieve net zero, it is sensible to plan for the possibility of a 2 degree rise in global temperatures by 2050. We need an urgent review of our strategy for adaptation and resilience to climate change. Many of the recommendations here could be equally applied to an approach to adaptation – indeed the whole systems approach advocated here should ensure mitigation and adaptation requirements are considered alongside each other. This work would be aided by more accurate climate modelling.

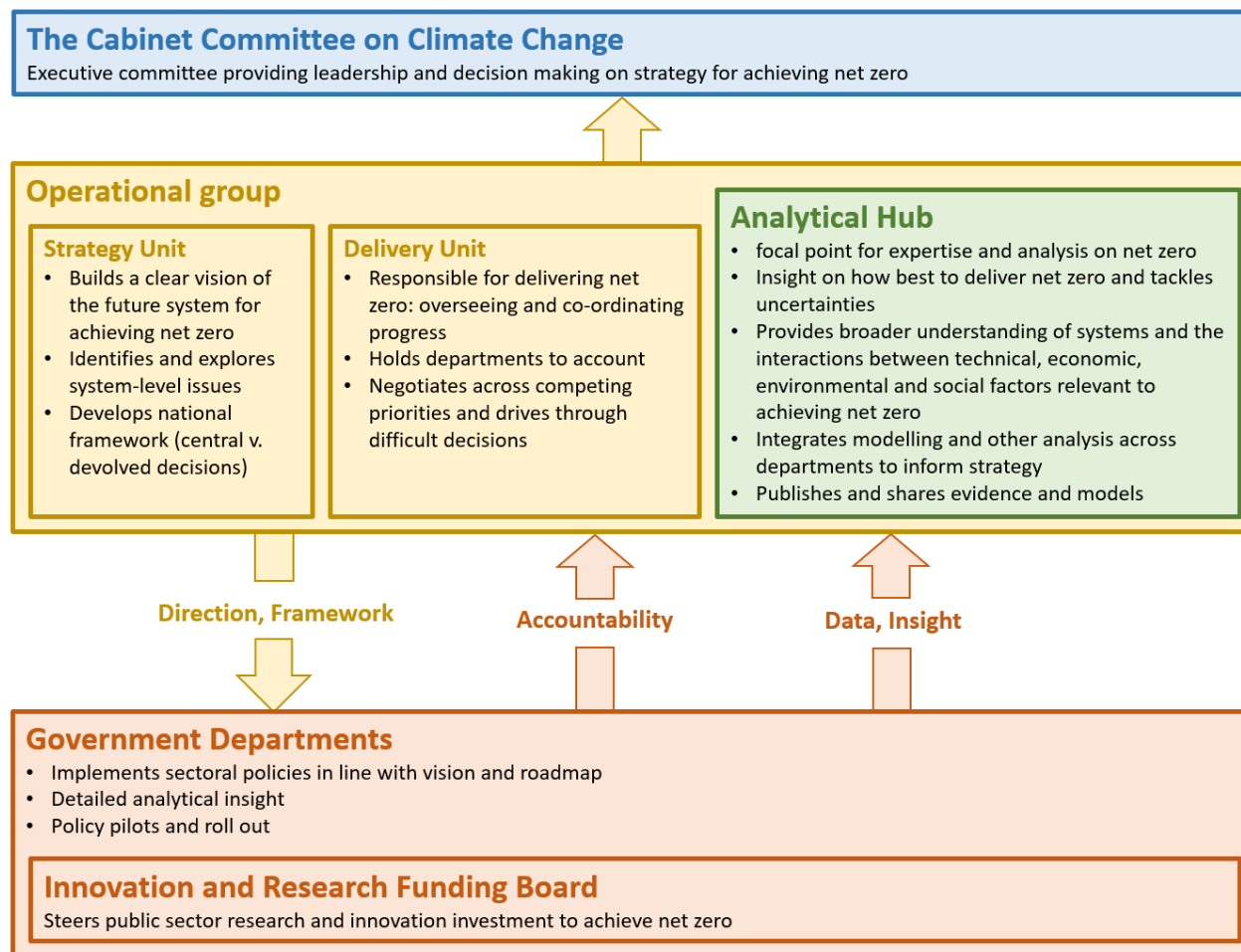
74. This is a challenge for cross-government coordination, just as with the net-zero target, and there will be opportunities for synergies to build in resilience to the effects of climate change while we upgrade and decarbonise our infrastructure. We welcome the NIC's upcoming work on the resilience of UK infrastructure⁷.

75. The Council would be happy to work with Ministers and officials to consider how the leadership and governance structures we describe above could be used to take into account the need to strengthen our national strategy on adaptation and resilience. This is also another area of strength in the UK research base with strong international collaboration and influence, and we welcome the inclusion of this theme in COP26 plans.

Council for Science and Technology, January 2020

⁷ <https://www.nic.org.uk/our-work/resilience/>

ANNEX A – Governance structure for a systems approach to achieving net zero



ANNEX B – Role of modelling and analysis as part of a systems approach

1. Modelling is an important analytical technique as part of a systems approach. Models enhance the quality of democratic decision-making. They can offer cost-benefit analyses of various policy options, manage risk and uncertainty, or predict how economic and social factors might change in the future.
2. The UK has a world-leading approach to using modelling to inform policy making on energy and climate change and there is excellent capability outside government to draw on. Despite this, there is a clear need to take modelling and its use to a new level.
3. To deliver the commitment to net zero, it will be important to maintain, develop and draw on modelling capability across government, develop it further, and promote exchange with experts in academia and industry nationally and internationally.
4. We welcome the work spearheaded by the BEIS clean growth team to develop a coherent cross-departmental approach and a set of interlinked models. This approach, with modelling capacity embedded in specific policy areas, forms a good foundation to build on. Better sectoral models will be needed in some hard-to-abate areas such as construction, aviation, shipping and agriculture.
5. Having a government-wide analytical group would boost ability to use modelling to inform policy and will make the basis for decisions clear. It could allow integration of insights from a wider set of models – that can be run alone or aligned as needed – including economic models in HMT, environment models in DEFRA, and socio-demographic models.
6. It would give an institutional home in government for models, data and high-level visualisation tools. Such a repository should also offer transparency of public sector modelling to promote collaboration with and innovation from modellers outside government and be a conduit to academic groups including those funded by UKRI (led by the UK Energy Research Centre) as well as analytical capacity held in consultancies and elsewhere. This will need investment in skills, computing power and infrastructure.
7. Interpretation of data analysis and modelling is fundamental to informing policy. This central analytical hub will be a beacon of expertise and independent information within government, which could serve as a template for integrating analysis across departments in other areas as well.
8. It will be important to retain skills and knowledge in the team to commission modelling, engage with outputs of models and interpret results. Senior civil servants should expect to play an important role as intelligent consumers for commissioning and using modelling.

9. There must be capability to align modelling with other techniques such as scenario planning (for exploring alternative approaches and test policy robustness) and deliberative mapping. This will build a better understanding of social and behavioural dimensions and how technologies work at scale.