ARUP

Transitioning to a Net Zero World

Complexity within sectors

October 2023

Transitioning to a Net Zero World

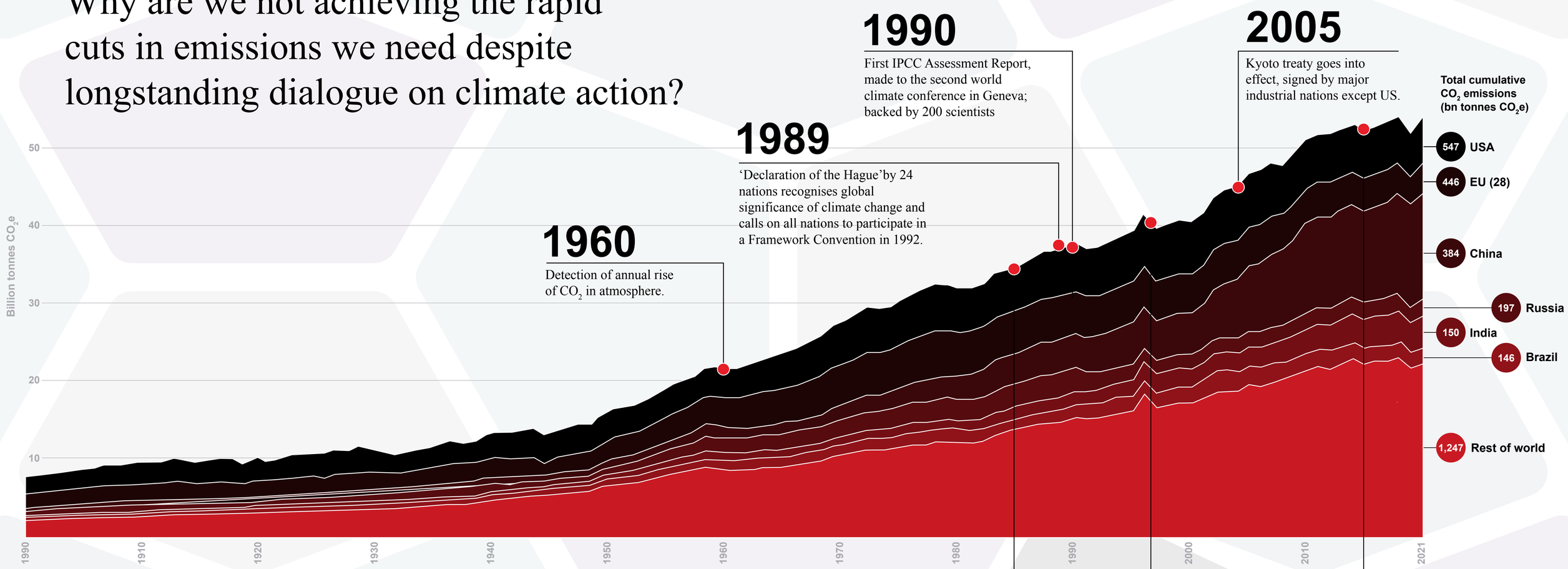
How can we shift from a period of limited change to transformational change?

Many technological solutions and visions for net zero cities, neighbourhoods, buildings, and products - while recently acknowledged at a mainstream level - have been discussed for decades. So, why is it that despite our knowledge of these ideas, and increasing attention towards them, we have not been able to make these solutions commonplace or achieve substantive reductions in global emissions?

When it comes to climate action, we primarily focus on what is needed in terms of solutions, actions, visions, plans. Our focus here is on exploring how we can effectively implement these solutions, and in particular the barriers in our path in doing so.

How do we achieve an at-scale transition towards a net zero world that goes beyond sectors and national boundaries? Our aim here is to bring attention to several issues and approaches that continue to be overlooked in the statements and solutions aiming to achieve net zero to date. We want to offer a unique and different perspective that takes a system level view, focuses on key barriers and corresponding enablers, and that highlights what is needed to truly achieve a transition to a net zero future.

Why are we not achieving the rapid cuts in emissions we need despite longstanding dialogue on climate action?



1960

Detection of annual rise of CO_2 in atmosphere.

1989

'Declaration of the Hague' by 24 nations recognises global significance of climate change and calls on all nations to participate in a Framework Convention in 1992.

1990

First IPCC Assessment Report, made to the second world climate conference in Geneva; backed by 200 scientists

1985

United Nations Environment Programme/ World Meteorological Organisation (UNEP/WMO) scientific conference calls for international action to curb emissions.

1997

Kyoto Protocol to the FCCC agrees nations to reduce emissions by 2012; signed by 163 countries.

2005

Kyoto treaty goes into effect, signed by major industrial nations except US.

2015

The Paris Agreement (ratified in 2016) signified international agreement (eventually by up to 125 countries) on strengthening the global response to climate change by aiming to reduce emissions and keep a global temperature rise this century 'well below 2 degrees Celsius above pre-industrial levels' and to pursue efforts to limit the temperature increase even further to 1.5 degrees Celsius.

Transitioning to a Net Zero World

Introduction

Achieving net zero at scale is more of a political, economic, legal, and financial struggle than a technical problem. Climate targets and regulations are set up nationally – while consumption and production take place globally.

Big businesses commonly announce targets to reduce their emissions but outsource emissions-intensive processes further down their supply chains. Large corporations still face little pressure from government to validate their statements on climate change targets. Net zero ambitions often serve more as marketing tools than as impetus for a truly transformed business model.

Governments around the world continue to struggle to understand the role they can play in driving change while delivering on urgent needs and maintaining socio-political stability. Scaling and implementing concepts such as a circular economy are still left to the market, overlooking the fact that the lack of clear regulatory and financial incentives for manufacturers and retailers backing the concept continues to favour an economy that relies on making and selling more new things. Far-off visionary net zero targets continue to lack near-term pressures to perpetuate the required level of change.

Through this study we question how pledges to action can be more effective. Are we focused on the right actions and commitments? Are we targeting the real barriers to a net zero transition?

Transitioning to a Net Zero World

Introduction

What do we mean by a net zero world?

The debate around the phrase ‘net zero’* continues, as does an increase in global emissions. Critics of the term net zero rightly point out that it can be used to justify inaction and excessive dependency on unknown and unproven technological solutions to mitigate climate change. In this study, we use the term net zero to represent the scale of the challenge, the general direction of travel for emissions, and to recognise that sequestration mechanisms will be required to some degree to achieve climate goals. Greenhouse gas emissions must be minimised to prevent temperature increase above 1.5 degrees and those emissions which cannot be avoided must be offset (removed) through available means – either through nature-based or technological solutions.

But we take note and guard against the loopholes within the term net zero, by making clear: the focus is first on minimising emissions as much as possible while still enabling vibrant lives for people and maintaining individual freedoms. After all attempts to achieve this balance, we must seek to sequester enough carbon, through nature-based solutions and then technological mechanisms, to remove carbon from the atmosphere to ultimately achieve and maintain a stable temperature for the Earth. Action on net zero must align as closely as possible with the need to become a more sustainable world.

While reducing greenhouse gas emissions is a priority, the planet is past its capacity to sustain human consumption in more than one way. This means that if action can be taken to reduce greenhouse gas emissions and simultaneously address other environmental and social issues such as waste, degradation of land, water and air pollution, or exploitation of people and resources, then it is the preferred course of action and should receive priority over solutions which exclusively cut greenhouse gas emissions. Actions to manage greenhouse gas emissions must also be assessed to ensure they do not worsen existing social, environmental and public health issues over the long-term.

Due to the ongoing delay in action on climate change and continued accumulation of excessive greenhouse gases in the atmosphere, we recognise that the sequestration of emissions from the atmosphere may indeed need to go beyond offsetting ongoing emissions and capture more greenhouse gases from the atmosphere than are actually being emitted at the time, in other words to achieve a ‘net positive’ effect. In the context of this study this differentiation between ‘net zero’ and ‘net positive’ is rather immaterial. Our focus is on understanding and addressing the barriers that impede progress on the transformational change required to meet these agendas.

*Formally, the term ‘net zero’ implies that we need to apply a mixture of decarbonisation and sequestration measures to rebalance the amount of carbon present in the atmosphere to optimal levels to stabilise the planet’s temperature. Getting to zero emissions requires decarbonising current greenhouse gas emitting operations as much as possible (by finding alternative to carbon-intensive resources or reducing or eliminating hydrocarbon use), and then using nature and technology to remove any remaining carbon emissions from the atmosphere.

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Overview

Challenges for a transition to net zero

In this work, we highlight three fundamental challenges to a successful, at-scale transition to net zero emissions. The aim is to build a common understanding of the barriers we must overcome and the unresolved questions we must tackle to enable the transition to a net zero world.

This document is the second release of a four part Foresight report exploring systemic challenges to a net zero transition.

1. Global Interdependencies (Released September 2023)

Business, industry, and consumption take place across borders – yet climate action will be delivered in the context of a nation's individual priorities and agenda. What does cross-border alignment look like in practice?

Featured narrative & analysis

Country Profiles: Understanding national perspectives

The global nature of agriculture & industry

2. Complexity within sectors

Each sector is made up of a complex set of systems and actors – who makes decisions and holds responsibility to action change and eliminate contradictions?

Featured narrative & analysis

Mapping the transport sector: Great Britain

Mapping the energy sector: Great Britain

3. Feasibility for consumers

What is sustainable, and is it practical and affordable? Make sustainable choices the default and the most competitive option for consumers.

Featured narrative & analysis

How easy is to make homes more energy efficient? Examples from UK, Austria, France.

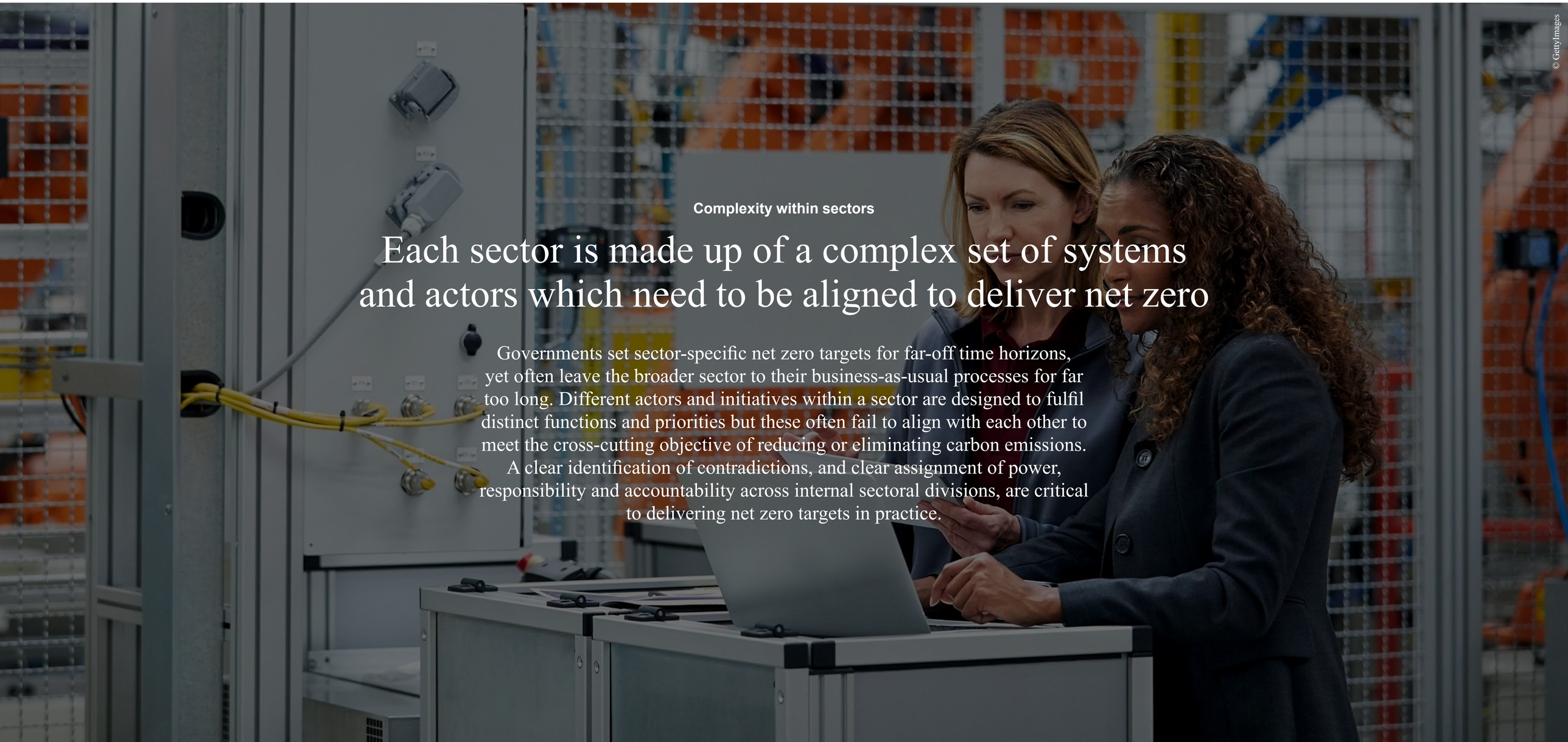
How easy is it to find sustainable products? Case study: tea & smartphones

Government and big businesses must start using every lever of influence in their power

Government sets the framework for production and consumption. Businesses are the link between individual choices and systemic provisions across national boundaries. Consistent and aligned action from government and big businesses is a necessary condition to overcoming the key barriers to the net zero transition.

Featured narrative & analysis

Recognising all levers of influence: Businesses | Government



Complexity within sectors

Each sector is made up of a complex set of systems and actors which need to be aligned to deliver net zero

Governments set sector-specific net zero targets for far-off time horizons, yet often leave the broader sector to their business-as-usual processes for far too long. Different actors and initiatives within a sector are designed to fulfil distinct functions and priorities but these often fail to align with each other to meet the cross-cutting objective of reducing or eliminating carbon emissions. A clear identification of contradictions, and clear assignment of power, responsibility and accountability across internal sectoral divisions, are critical to delivering net zero targets in practice.

Complexity within sectors

Delivering net zero targets in each sector requires taking a full systems view

Who holds responsibility within a large and complex sector for making decisions, taking action and eliminating contradictions towards net zero goals?

Each sector is shaped by a range of actors, functions, and incentives that together make up a system. Carbon emissions are an output of these systems. It is usually unclear who holds responsibility for aligning decisions within the system (between different existing actors, initiatives, and incentives) to prioritise measures across internal sector divisions, and deliver the overall required emissions reductions.

There is no doubt that understanding and specifying where change needs to be made and who should drive reform is difficult and risky given the high-degree of complexity and the lack of easily identifiable optimal solutions.

However, sector-specific net zero targets could be made more powerful and meaningful, if they are followed by a clearer acknowledgement of the unresolved questions, the associated options and risks, the trade-offs, the connections between different measures, and the hierarchy of collective priorities for all major stakeholders and decisionmakers. This is hard to accomplish because high-level government leaders advocating for change and the net zero agenda often may not understand the full sector ecosystem. On the other hand, those within the sector view, portray, and prioritise critical needs primarily from their own perspective.

A full sector view provides clarity on the source of tension emerging from proposed change, whether contradictory efforts are taking place, who is at risk due to prevailing uncertainty, and where critical decisions and restructuring need to take place.

Complexity within sectors

Are sectors, such as transport and energy, organised to deliver net zero?

To understand the complexity of the net zero transition at the sector level – we considered the energy and transport sectors in Great Britain.

Are the right incentives, resources, and powers in place for each actor to play their necessary role for a timely transition in these sectors? What would it take at every point within this system to achieve net zero?

Overall, the Great Britain (GB) energy sector is a good example of proactive, rigorous, and coordinated action across a sector to meet the demands of the net zero transition. Despite this, it continues to grapple with a series of fundamental questions that remain unanswered, slowing the pace of progress towards net zero.

In contrast, the GB transport sector is only beginning to explore and grapple with the organisational and delivery demands of a net zero transition.

Explore the UK Energy Sector Map

Explore the UK Transport Sector Map

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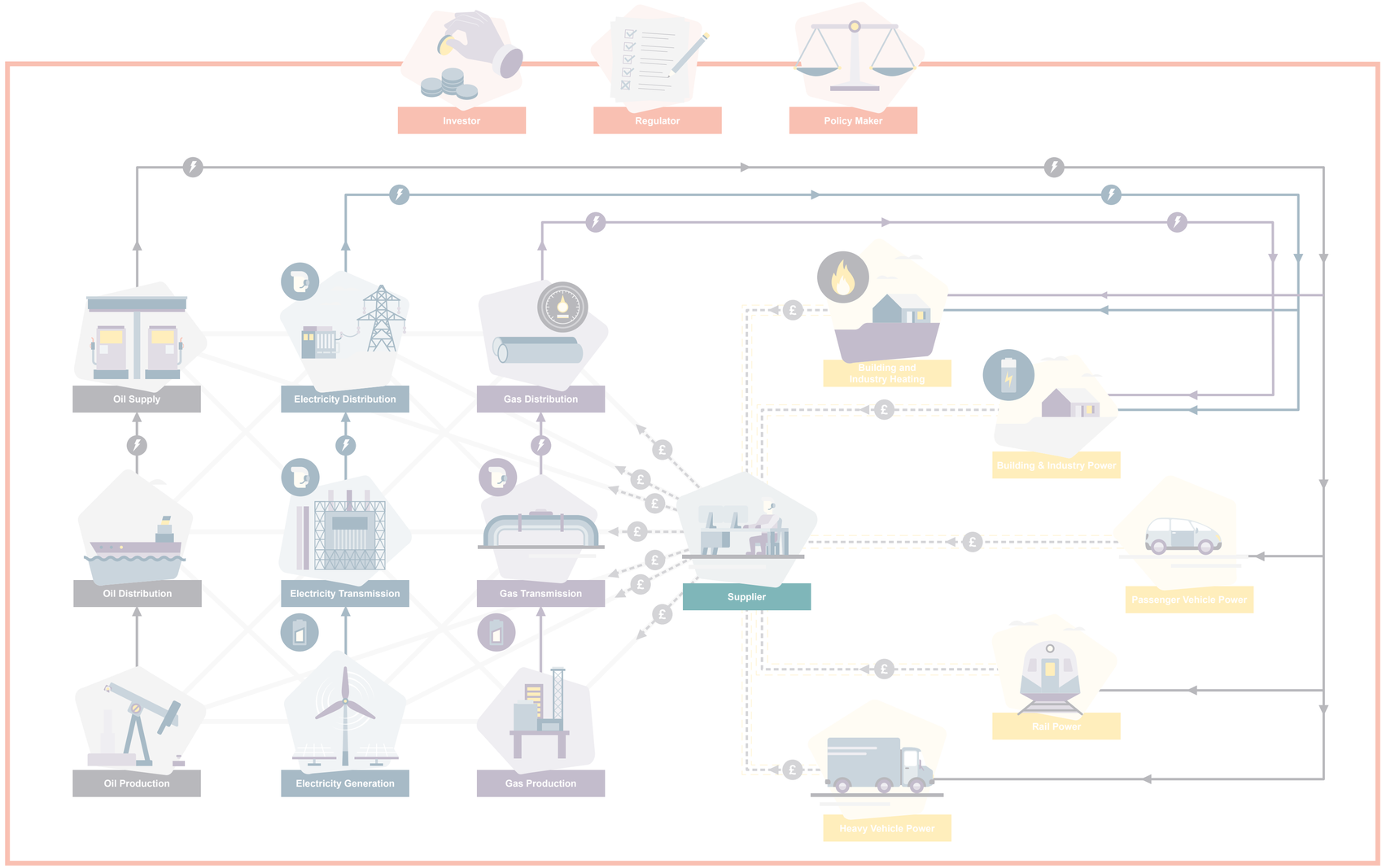
GB Energy Sector Map

Who holds power and primary responsibility to drive and accelerate the energy transition to net zero?

Electricity, heating, and cooling constitute the largest share of emissions in every part of the world. How we get energy for different uses is the result of an interplay between a large set of actors and powers in a complex system. Some of these actors are drivers of change and others more often respond to the actions of others.

Explore the interactive UK Energy Sector Map



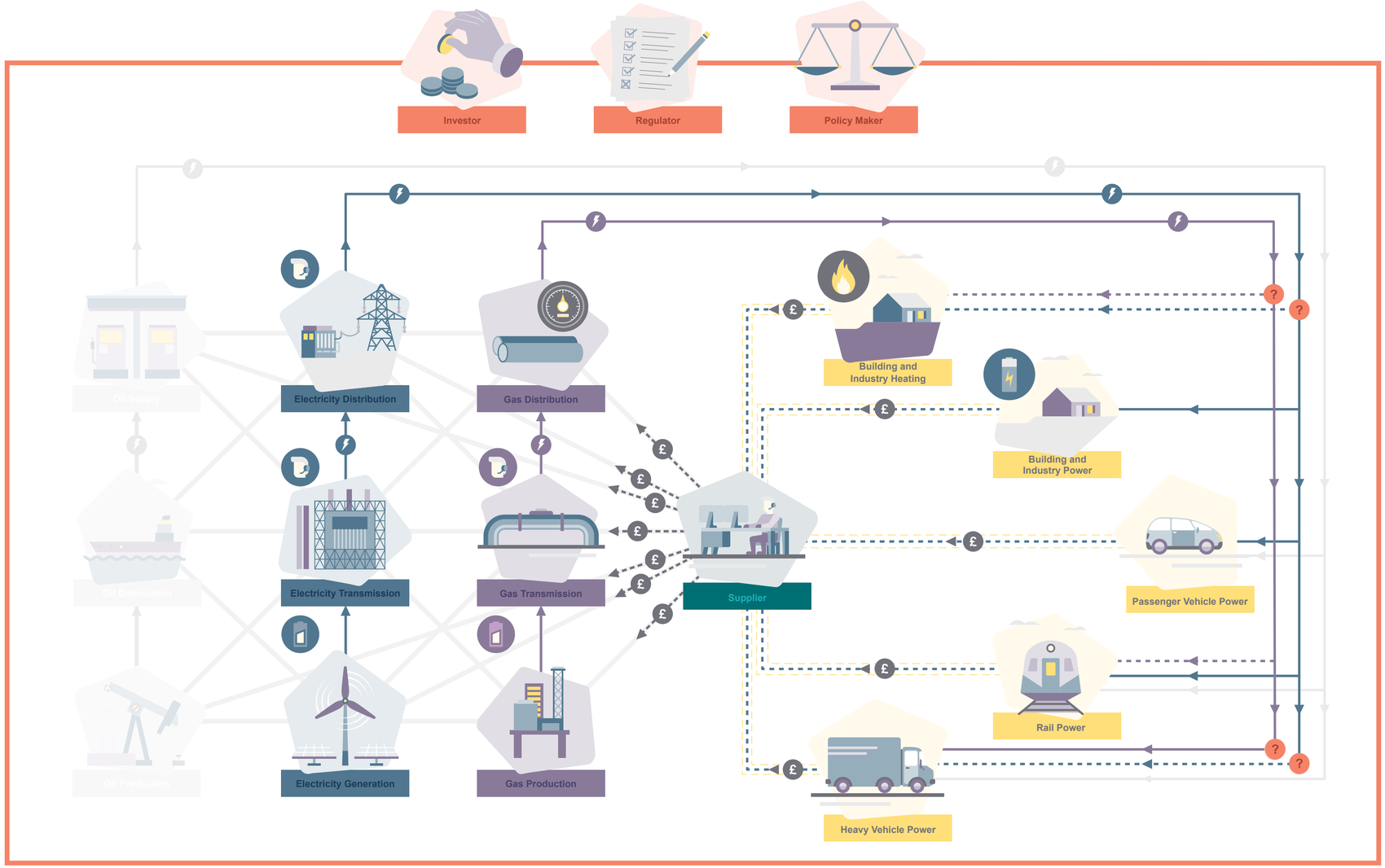
GB Energy Sector pre-transition

GB Energy Sector Map

Roll over the agency names to understand their current role in the energy sector.

The sector map identifies the main actors of the GB energy system and their role in the sector. Smaller energy vectors are not shown.

Read our overview of key challenges for achieving net zero in the energy sector



GB Energy Sector post-transition

GB Energy Sector Map

Recognising the specific systemic challenges for the energy sector

The demands of the net zero transition create stresses in the current energy system, with unclear pathways to a solution. In considering the core actions needed to bring the GB energy sector to net zero, a series of transition problems emerge that touch multiple components of the current energy system, and involve complex trade-offs and significant uncertainties.

Although most of these problems are recognised and even well understood, existing governance structures perpetuate indecision and a lack of clear ownership over addressing these issues. Key decision makers who could reshape the system are only just starting to articulate a clear position and setting a firm plan for action.

High market uncertainty hampers long-term investment in energy alternatives

The future of the gas network

The transition to net zero provokes a fundamental question around the future of gas. Natural gas is currently used to heat buildings in the UK, and also for high temperature industrial heating processes. To decarbonise heating, either natural gas needs to be replaced by a clean fuel such as hydrogen, or heating systems would have to be electrified – requiring each user to install heat pumps and go through a process of electrification retrofitting.

In theory, if everything could be electrified, does a gas system need to exist? Or should we leverage its existence to the advantage of net zero transition?

The debate around the future of gas in GB is still ongoing, in particular on the potential role of hydrogen. The UK Climate Change Committee estimates new demand from transport, buildings and industry (even with improved energy efficiency) would result in a 50% increase in electricity demand by 2035, and potentially double or even triple by 2050 (even in a scenario which assumes significant scaling of hydrogen production)[1].

Dependence on intermittent renewable energy supply to meet 24-hour demand for electricity would require the ability to store electricity for hours, days, and potentially months – something that from a physical and technical standpoint is currently largely unfeasible. Some of the core challenges relating to electrification can be circumvented in a scenario where hydrogen replaces natural gas. In contrast to the problem of electricity storage, greater capacity to store gas already exists.

The electricity sector is ahead of the gas sector in defining its role within a net zero transition. To some degree this is because it has, for decades, received strategic attention, subsidies and investment arguably exceeding those made available by government for clean gas solutions. The privatisation of the energy sector and vested interests in gas as opposed to electricity make it all the more complex to objectively understand the costs and benefits of the different energy options.

The critical uncertainties on the future role of gas are around the ability to produce and distribute decarbonised hydrogen at scale and at an acceptable cost, and in predicting the level of demand clean gas could address, where electrification becomes too challenging and costly.

There is also an emphasis on deploying hydrogen for ‘hard to decarbonise’ applications, either directly, or through hydrogen derived synthetic fuels. Correctly navigating these uncertainties would allow government to optimally invest in both energy solutions, while protecting consumers against high costs and guaranteeing a resilient energy system. Continued delays in decision-making on the premise of uncertainty and imperfect information would risk losing the only remaining feasible pathway to net zero.

The role of Carbon Capture, Utilisation, and Storage (CCUS)

The role of Carbon Capture, Utilisation, and Storage (CCUS) in an energy transition continues to be the subject of debate and speculation. Its viability and case for implementation will vary across regions and nations, while in some sectors, such as heavy industry, CCUS is the only way to decarbonise key operations. Energy alternatives such as blue hydrogen (generating hydrogen fuel by breaking down natural gas and then capturing the resulting carbon dioxide) also fundamentally rely on CCUS technology.

GB Energy Sector Map

Recognising the specific systemic challenges for the energy sector

The cost and regulation relating to the storage of captured carbon is a challenge and a significant amount of infrastructure is needed to transport and store even a small amount of carbon. Based on intelligence from efforts on demonstration projects, the capital required to install CCUS at a coal- or gas-fired power station has been estimated to be between £1 billion and £2.5 billion (2019 figures), with some estimates suggesting cost can be reduced down to under £500 million (2019 figures) given new developments in the industry.[2] The cost/benefit analysis is only in favour of implementing CCUS where a large volume of carbon is being captured (and where carbon emissions are priced appropriately). Responsibilities and liabilities are uncertain too. Who in government can guarantee the safe storage of captured carbon for hundreds of years to come?

There are also technical issues. CCUS will become increasingly unattractive for gas- and coal-fired power plants which will operate with ever increasing intermittency due to the expansion of renewable energy. CCUS processes need a steady state environment to work optimally, and shutting off and on is problematic and ineffective.

There are unanswered regulatory questions around the relative status given to future CCUS power plants. CCUS reduces the energy efficiency of powerplants – running CCUS processes is estimated to increase the energy consumption of fossil-fuel powered stations by between 11%–40%.[3] Energy efficiency is used to prioritise which powerplants are used first and most often for dispatching power in real time to match demand. Regulation and prioritisation schemes will need to reconsider lower efficiency powerplants that operate with CCUS because of their overall cleanliness. Yet, such power plants will still be lower in preference against the growing market of renewable energy plants. This brings into question: what is the incentive for gas/coal-power plants to feature CCUS? What will the investment in expensive CCUS powerplant retrofits deliver for the long-term future of coal/gas-powered powerplants? The answer would ideally be informed by an overarching strategy which balances the costs, constraints, positive and negative impacts of both scaling renewable energy and using CCUS on existing fossil-fuel based powerplants to achieve an overall net zero state.

For nations with large heavy industry operations (where the process itself emits carbon dioxide – e.g. such as cement manufacturing – and energy decarbonisation alone does not provide a comprehensive solution to achieving net zero emissions) CCUS technology has a more certain and significant role to play, and its deployment should be progressed at a faster rate. Overall, the key question remains to be navigated by all sectors and states seeking a path to net zero. What is the right balance between scaling renewables and implementing CCUS, and how does this vary based on regional/national characteristics and over the different phases along the transition?

The cost burden of the transition needs a clearer management strategy

There are few low-cost options left for harnessing renewable energy. The next phase of expansion for renewable energy sources such as offshore wind farms will cost significantly more as they penetrate into deeper water and require the use of new technology for installation.

Decarbonisation plans for buildings and transport increasingly rely on future electrification, yet large scale electrification of building heating and transport is unfeasible without major investment in energy transmission and distribution networks, and into grid resilience. The UK Climate Change Committee estimates that the total additional capital investment required under a Balanced Net Zero Pathway (compared to a high carbon system) will rise to around £15 billion in 2035 and £5 billion in 2050.[4] New demand from building heating and transport will lead to higher levels of peak demand for electricity, necessitating investment in new infrastructure so that energy is available to meet increased demand. The need to finance new energy infrastructure may require energy suppliers to introduce new pricing structures – ultimately implying more costs for consumers and taxpayers.

Transition to date has been supported by subsidies and schemes such as the Renewable Obligation, Feed-in-Tariffs, Contracts for Difference. Ultimately consumers bore the increases in costs associated with these schemes. Previous attempts in the UK to stop subsidies for renewables, so as to reduce the rise in consumer electricity costs, contributed to a stall in onshore and solar energy investment and growth. Despite the breakthrough of renewable energy sources in the market, investors are still hesitant to fund projects that do not come with government guarantees, or that might lead to reduced returns.

GB Energy Sector Map

Recognising the specific systemic challenges for the energy sector

The complexities and the high social and political risks associated with creating and implementing a new plan to price energy, in order to finance the energy transition, impede timely action on the net zero agenda.

A series of fundamental questions around the costs of the transition still need to be directly addressed and resolved:

- How can government create greater confidence in the market without relying entirely on subsidies to attract investment in clean energy?
- How does government retain/replace sources of fossil fuel-based revenue in a mass shift to electrification?
- How can the costs of the energy transition be optimised (without delaying the pace of the net zero transition) and distributed equitably? What is the right pricing structure?

Consumers must be brought onboard to adopt and actively support the transition

Actions required to successfully decarbonise the energy sector rely heavily on consumer choices and active support from the public. But what does the climate crisis-ambivalent consumer gain from the cost and disruption of an energy transition?

Currently, the shift to clean energy means nudging consumers to switch to electric vehicles, expecting them to actively initiate and absorb the significant disruption, time, and cost associated with retrofitting their homes, as well as relying on them to pay more for energy usage to cover the costs of new energy infrastructure and upgrades.

Government reluctance to specify a direct and firm pathway to net zero energy is, to a large degree, driven by the need to ensure consumers are not exposed to unacceptably high costs or penalties. The caution required to protect consumers is at odds with the decisiveness needed to deliver net zero targets in time - an inherent tension that needs to be recognised and strategically addressed by governments to deliver a successful and timely transition.

Recent events – from high inflation to the Russian invasion of Ukraine – have already increased the cost of living sharply for consumers in the UK and pushed the government to take action to protect consumers, while keeping on track to move towards net zero targets. In 2022, the UK government introduced various schemes to further support caps on energy prices for domestic and commercial energy users; while also initiating a temporary revenue limit for energy generators through the ‘Cost-Plus Revenue Limit’ scheme.[5]

Innovation in energy market pricing will be an inevitable and critical component of the transition to a net zero energy system. The current volume of individual energy companies responsible for the provision of energy to consumers in Great Britain implies any policy change affecting the future roles of electricity and gas (and its providers) needs to come with comprehensive and coordinated customer service solutions. A clean and intuitive customer-facing interface to help consumers navigate the resulting changes to their energy options with ease and assurance will ultimately be essential for any transition policies to be accepted and adopted, smoothly and successfully.

New energy tariff structures and consumer-facing incentives to accelerate the net zero transition will need to consider how price increases affect different ‘types’ of customers, how policies can guard against greater inequity and increasing fuel poverty, and how the shift to clean energy can ultimately be made easy, intuitive, and attractive for consumers.

Who holds power and primary responsibility to drive and accelerate the transition to net zero?

The energy market consists of an array of entities. Some are drivers of change and others more often respond to the actions of others. Government, in its role as the policymaker and regulator of the energy market, is a primary driver of change. It also holds the primary responsibility to achieve the transition to net zero, and therefore must activate change and understand how it can best accelerate and align action towards net zero in the energy sector and protect consumers against the risks of disruptions and market distortions.

Yet, government cannot directly intervene in everything that is needed for change in a system that is complex and interdependent. Stability in government position and policy is key for investors who provide the funds to enable change in the first place. Disruptive changes in policy can unsettle markets. The market must be onboard with the government’s direction of travel for change to occur, and for policy to succeed in achieving its aims. The role of government is to create the right market mechanisms through incentives, policy, rules for investors and suppliers that activate and continually push forward the transition.

Government is also highly sensitive to the perceived reaction of voters and taxpayers. Acceptance of radical change in policy from the public constrains government action from being radical or from inviting above average risk, even when the evidence suggests that decisive, radical action is required.

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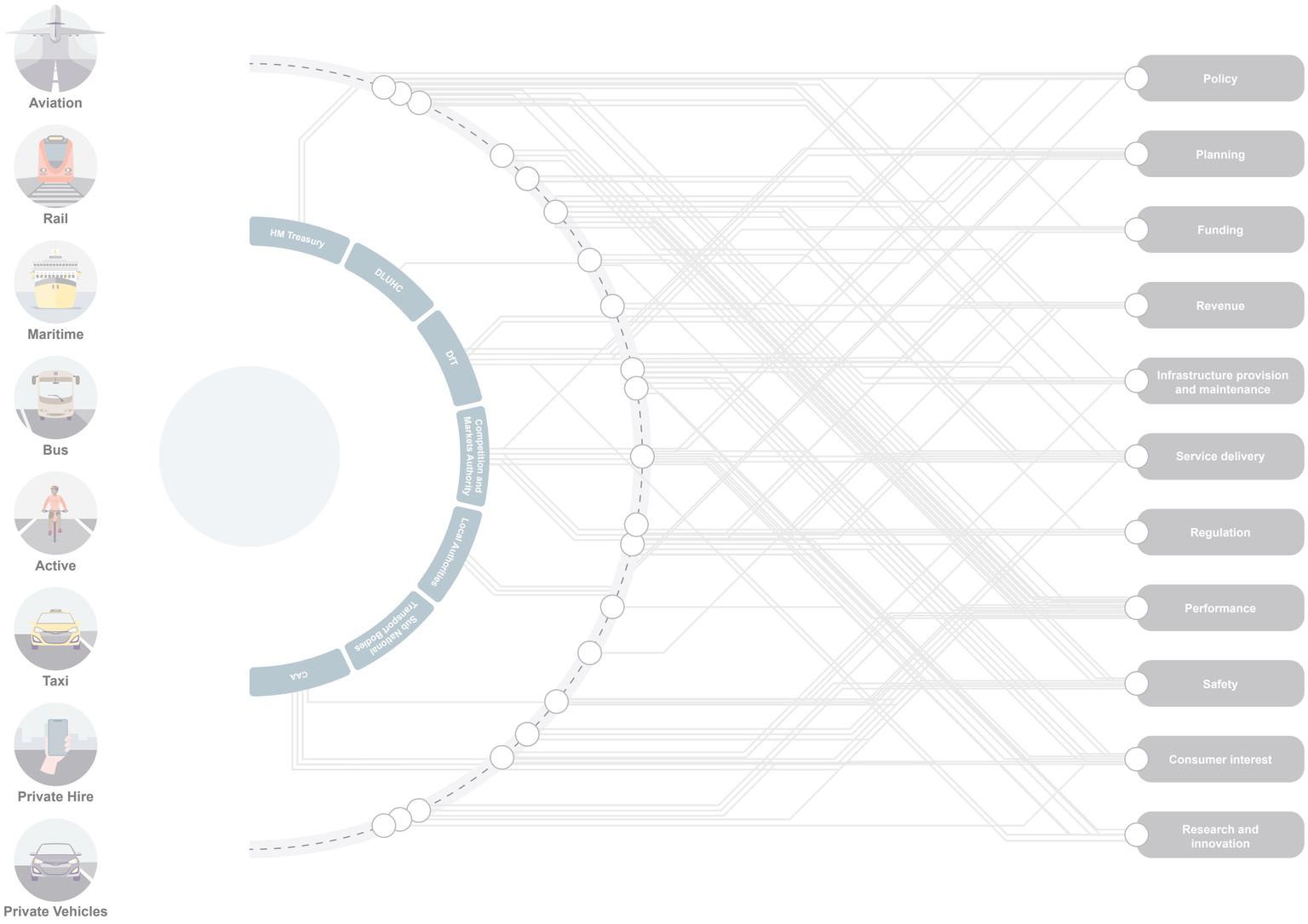
GB Transport Sector Map

Who is prioritising the delivery of net zero targets across the transport sector?

In the transport sector, each mode of transport often has its own complex planning, policy, operations, and infrastructure delivery and maintenance agencies – some public and some private. Their individual powers and responsibilities overlap and collide to meet the demands on the transport network and provide a set of standards that, today, primarily emphasise functionality.

This transport 'sector map' illustrates a key issue in positioning the transport sector to achieve net zero carbon. No entity within the transport sector has direct power or responsibility to ensure that the goal of achieving net zero emissions is practically aligned with the existing core functions of all key organisations and authorities within the sector. Where does the need to actively prioritise decisions that deliver a net zero network fit into this dense network of functions and aims?

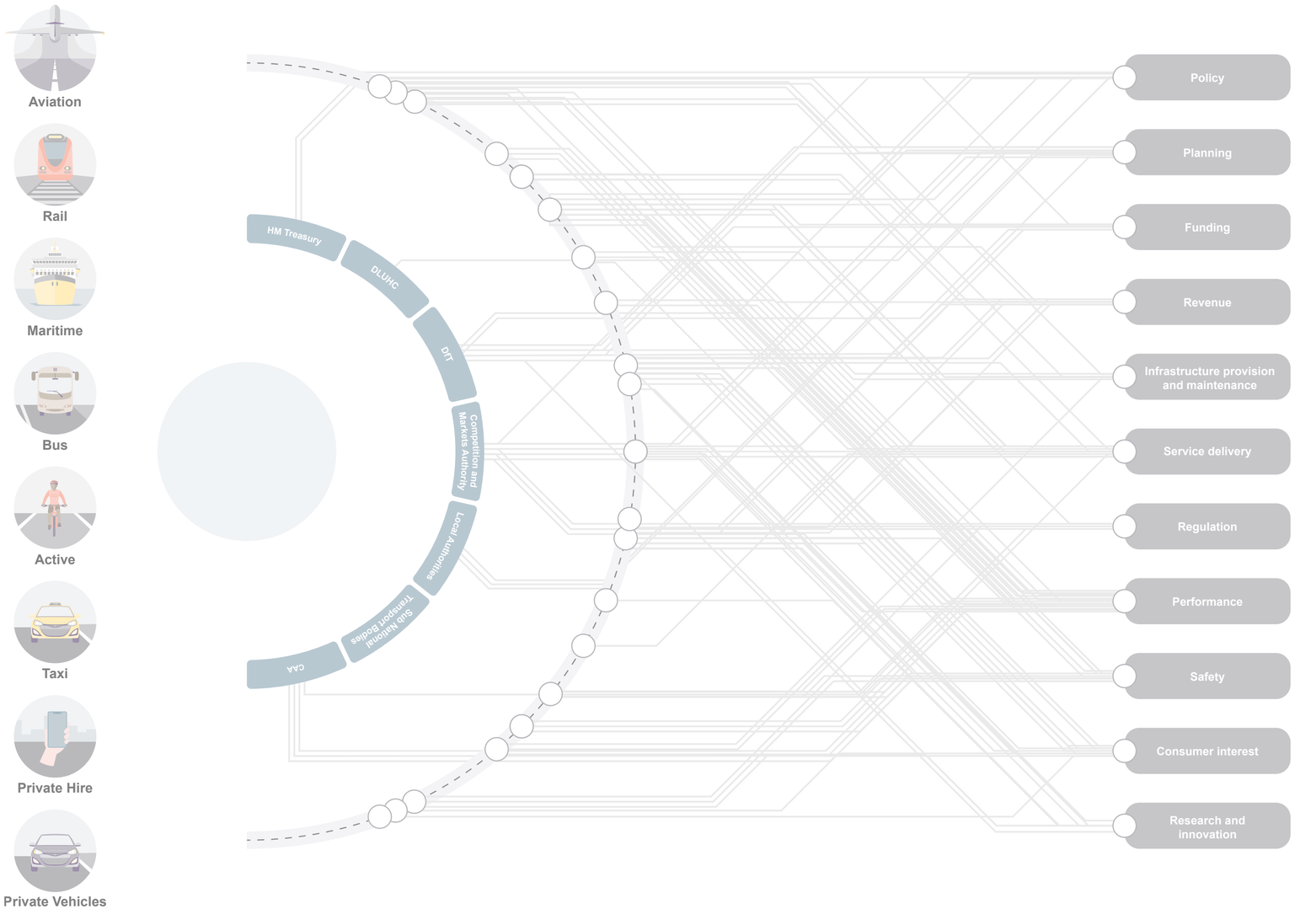


Explore the interactive UK Transport Sector Map

GB Transport Sector Map

Roll over the icons to learn more about each agency

The sector map identifies the main actors of the GB transport system and their role in the sector.



Click to exit the map and read our overview of key challenges for achieving net zero in the transport sector

GB Transport Sector Map

Recognising the specific systemic challenges for the transport sector

Why alignment across the sector is critical to achieving net zero

Transport investment in any nation or region is driven by multiple agendas. In many jurisdictions decarbonisation is not yet as high of a priority relative to connectivity or economic growth as a driver for new transport infrastructure projects. In Britain, the transport sector is managed by both private and public entities operating across the various modes of transport. They are often split between network provision and service provision, with most having mode-specific functions. Mode-specific planning and investment decisions therefore traditionally tend to be made largely independently by these entities. Individual transport projects and services can be driven by subnational government agendas, or by landowners and developers seeking to catalyse growth or regeneration, or by transport operators seeking to increase revenue. All in all, there are often multiple competing aims and interests, with multiple players involved. Thus, actions arising from these different agendas will not always be as efficient as possible or fully aligned in meeting Britain's net zero goals, and specifically in meeting the carbon budgets Britain has adopted.

Requirements in transport appraisals to consider net zero targets are being implemented, but do not yet 'fold up' to a total picture as to how these will contribute to a reduction in the transport sector's total emissions. Thus, recognising rapid progress and change in the last few years, efforts to ensure that major transport projects align with Britain's net-zero goal still remain an evolving picture.

While there are numerous subnational transport plans and strategies, and individual efforts by transport organisations to move towards net zero, there is no integrated national transport strategy for Britain as a whole or for England. Fragmentation of transport planning and functions between competing bodies, does not produce coherently planned transport networks and services. This makes it difficult to create accountability for net zero targets.

Even within a specific mode of transport like rail or aviation, organisations hold distinct and exclusive priorities, as illustrated on this map. This organisational structure has kept the delivery of transport smooth and provided a higher quality of service and network standards. The separation of responsibilities and oversight over different networks is, to a high degree, also essential given the vastly different technologies and delivery, performance, and safety requirements, relating to different modes of transport. The influence and ownership in some cases of the private sector over transport infrastructure and services, while increasing fragmentation, has enabled more efficient, cost-effective, and/or higher quality delivery.

Transitioning to a net zero transport system is dependent on three things:

1. Mode shift (near/medium-term) – maximising the shift of trips onto more sustainable transport modes.
2. Power shift (near/medium-term) – adopting the use of sustainable fuels or sources of energy for powering transport vehicles.
3. Demand reduction (medium/long-term) – Reducing the need for vehicle usage by increasing provision of local services, better land use and development planning, and by leveraging digital technology.

In this section, we argue, that each of these three methods to reduce transport emissions require cross-modal and integrated planning within transport and regions at a higher level than ever previously seen.

Sector divisions act as a key barrier to sustainable modes uptake

Across the three different methods outlined above for achieving zero carbon and sustainable transport, mode shift is key. A full power shift requires a complete transformation of all transport vehicle fleet (freight vehicles, buses, rail cars, private cars) as well as the full decarbonisation of the national electricity grid, and the roll out of hydrogen or other clean fuels – the scope and timing of which is still uncertain and under debate. Reducing the need for vehicles requires a transformation of the built environment, likely to take a long time to complete.

This means that, while we wait for technology to progress transport modes towards clean fuels and for development planning and land use to bring sustainable transport to the forefront over the long-term, maximising mode shift towards active travel and public transport will need to play a primary role in reducing emissions in the near and medium term, if we are to reach net zero targets in time.

GB Transport Sector Map

Recognising the specific systemic challenges for the transport sector

However, maximising mode shift from air to rail, cars to active and public transport requires fully integrated and aligned planning and decision-making, and operational coordination across all modes. When people make choices on how they travel, they compare convenience and costs across modes. This means that in order for the more sustainable mode to be more often chosen by the average individual, the relative prioritisation of modes across key corridors has to be right. Alignment in strategy across modal systems is necessary to ensure the more sustainable modes of transport are, on average, the most competitive (offering more convenience, higher accessibility) along key routes and corridors.

Competitiveness between organisations and businesses with vested interests in separate transport systems helps to promote quality and a range of options and services for consumers. But it also creates a barrier to practically giving priority to sustainable modes as often as possible. It also prevents optimising flows and sharing capacity across modes and operators to minimise carbon impact.

Separate fare structures for different modes (which are comparable for a given journey type, e.g. rail and air), passenger communication, and vast differences in convenience and user experience can entrench disadvantages for modes that are now increasingly important to encourage from a carbon and liveability perspective. Siloed planning and operations also lead to a skewed understanding of transport connectivity gaps and needs, since information is scattered across different parties and not shared and centrally available to get a full picture view. This can promote suboptimal proposals for new infrastructure projects by bringing projects stemming from powerful project sponsors to the forefront rather than deriving project proposals based on objective assessments of system needs and potential solutions.

The current market-heavy approach for delivering transport infrastructure means more carbon-intensive modes that have historic competitive advantage have superior access to funds, right of way (priority for space), and influence over consumers against more sustainable modes of transport.

Legacy prioritisation and decision-making methods continue to be applied in mode-specific silos without consideration of how pre-existing frameworks must respond, restructure, and integrate across different modes of transport to reduce emissions and mitigate climate change. Current fragmentation in the sector results in loss of accountability and a lack of definitive progress in carbon reduction of transport.

Clear mode share targets and specific reductions in fossil-fuel powered vehicles will need to be set and achieved for actual progress towards a net zero transport sector. This step requires strong alignment across multiple actors, and clear, binding specifications. The levers government and other key decision makers will utilise and dedicate to set and achieve specific mode share targets or reduction in fossil-fuel powered vehicles across the nation, are still ambiguous. The consequences of failing to meet interim targets (where they exist) have not been articulated. There is little incentive for key actors in the transport world to work towards a step change in emissions and consider prioritising carbon reduction above business-as-usual priorities.

Transport needs cross-modal and consumer-oriented planning

Activity on the transport system is the cumulative result of individual choices coming together in time and space. The transport network and services provided by transport decisionmakers influence these individual choices but does not entirely define them. People's preferences for travelling and using certain modes of transport are driven by where they live, what they find convenient and attractive, their schedules and needs for services, and what they can and are willing to spend. A wide range of contextual factors and trends such as ageing, automation, land use development, and digitalisation are influencing transport choices.

A key challenge with achieving zero emissions in transport in time is the need to influence individual choices at a rapid pace, implying the need to align and coordinate these very different elements and dynamics that affect transport choice.

GB Transport Sector Map

Recognising the specific systemic challenges for the transport sector

The growing influence of technology-based private transport providers that have emerged over the last decade have focused on optimising individual convenience, arguably often at the expense of system-wide performance, efficiency, and sustainability. They have been successful in changing individual choice at a large scale due to their user-centric approach. In some ways, this is an example of what public transport planners and transport strategists must start doing more of to bring consumers onboard and meet the demands of a net zero target.

In addition, many transport choices, once made, have a long-term impact and will take time to reverse or change. For example, the choice to buy a home or open an office, store, or warehouse in a given location, or the choice to buy a certain type of car, will each lock in impact for several years. This emphasises the urgency of rolling out cleaner vehicles in time, managing land use and development decisions strictly in line with net zero ambitions to ensure sustainable transport behaviour, and regulating the unintended impacts of new transport or technology services, well ahead of a 2050 deadline to achieve net zero.

External barriers to the pace of change are too important to ignore

The dependencies between the transport sector and technology, the energy transition, and land-use development further complicate and slow down the sector's ability to deliver on the net zero agenda. The contextual changes required to enable zero-carbon transport are significant and in ordinary circumstances, they involve a long period of transformation.

- Land-use transformation: Reducing the need for vehicle trips in car-oriented environments, and increasing the viability of sustainable transport for individuals in these areas (i.e. mode shift) is dependent on the presence of complementary land use and development. In towns and cities currently designed to make car travel convenient, this is something that requires consistently aligned decisions around development, urban design, transport pricing, and user experience – inevitably taking a long time to transform travel behaviour.
- New infrastructure: The introduction of major transport infrastructure and services to provide access to public transport, in places that currently lack competitive public transport alternatives, creates significant disruption. Under existing project approval and delivery processes these projects garner significant public challenge, stakeholder debate and, as a result, significant delays.
- Energy transition: The electrification of transport and making vehicles less harmful for the environment depends on the pace of the overall energy transition. It relies on access to critical rare earth metals, the decarbonisation of electricity grids and the ability to scale and adequately provide sustainable fuels, fleet, and corresponding infrastructure.

This dependence on factors external to the transport sector, coupled with the fragmentation of the transport sector, itself creates major challenges in effectively and swiftly taking action towards net zero. Governments have declared net zero goals for the transport sector but still have much more to do in recognising and aligning the transport sector to address these specific cross-cutting challenges, which hold significant implications on the pace of change feasible to deliver a timely transition to net zero.

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Endnotes

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