REA

DECARBONISING TRANSPORT

ENABLING LOCAL ENERGY SOLUTIONS

Hitachi Energy

A CASE STUDY: SOUTHAMPTON AND THE SOLENT

Contents

Decarbonising Transport

Enabling Local Energy Solutions

Foreword
Dr Nina Skorupska CBE FEI, CEO, REA

In our drive to reach net zero, the decarbonisation of transport undoubtedly presents the greatest challenge. Over recent years, we have seen exponential growth in the sales of electric cars and vans, supported by a growing EV charging infrastructure network. By comparison, little progress has been made to decarbonise the "harder to reach" areas of the transport system: heavy road vehicles, shipping and aviation. REA as an association represents all forms of transport decarbonisation and this gives us and our members a unique insight and perspective.

Our report is based on a case study of Southampton and The Solent, as a location that features international transport hubs across land, sea and air. The report makes clear that, across all of these modes of transport, a great deal of investment is required to achieve net zero by 2050. Through consultation with local stakeholders, the report identifies that, in order to unlock the necessary investment, co-ordination is required to provide certainty and confidence, but also to plan and deliver enabling infrastructure.

Across land, sea and air, many of the essential components of a net-zero transport system are shared. High-power grid connections and renewable energy generation assets are required to deliver rapid electric vehicle charging, provide shore-to-ship electrical supplies, and to produce truly zero-emission hydrogen. Infrastructure is required to produce, distribute and supply renewable transport fuels to rapidly reduce whole-life emissions in areas of the transport system that cannot easily be decarbonised using electricity or electrolytic fuels.

Considering how much of this infrastructure is cross-compatible between different modes of transport, it is clear that the planning and delivery of a net-zero transport system will require cross-sector co-ordination. Whilst this co-ordination is required at a national level, it is essential that the same joined-up approach is consistently applied at a local scale. Doing so will contribute to an equitable net-zero transport transition for local residents and provide local businesses with the confidence to make long-term investment decisions in net-zero transport technologies.

Our thanks go to Hitachi for their generous support of this report, without which it would not be possible, to Robert Hull, the report author, and of course to the organisations and local businesses who have taken the time to engage with us on this in the Solent region. We hope this report can be used as a springboard for the positive actions already planned locally, and by other local authorities and regional governance bodies around the country to support their own energy transition.

REA TRANSPORT

www.r-e-a.net

Decarbonising Transport

Enabling Local Energy Solutions

Foreword
Ian Funnell, CEO, Hitachi Energy in the UK & Ireland

Transport is the largest producer of carbon emissions in the UK. Consequently, the transport sector's pace of decarbonisation will be key to delivering the country's ambitious goals for helping limit global temperature rise. The criticality of transport decarbonisation is why Hitachi Energy was keen to support a report that reflects the needs and ideas of the main stakeholders involved. The report recommends positive actions that can be taken today to start the journey to a zero-carbon transport system.

Transforming the existing transport system in the Southampton and Solent area - a region with all modes of transport and energy constraints - into a zero-carbon, passenger, and freight centric system, is not going to be easy. However, it is a transition that must happen and not just in Southampton, but in many other port cities across the UK and the rest of the world.

As the report explains, this transformation could be achieved as an uncoordinated, slow and costly set of independent steps. An integrated and coordinated approach, is clearly the way such transformations should be delivered. Considering the needs of all transport modes, as well as the low carbon energy sources needed, offers a better, cheaper and faster approach. However, this requires someone to take overall responsibility and control across the entire eco-system.

I welcome the report and am particularly pleased that its recommendations, which include many tangible actions that can be taken forward immediately, are supported by those key stakeholders that supported the development of the report and, in many cases, will be responsible for implementing them.

Our thanks go to the report's author, Robert Hull, the team at REA and the stakeholders in Southampton and Solent. I trust readers will find the report informative and I particularly encourage readers involved in decarbonising other regions of the UK to identify those features and recommendations that are applicable in their own situations. Please do reach out to the report team for further information.

Hitachi Energy

www.hitachienergy.com

Summary

The transport sector, including road, rail, aviation, and maritime transport, currently accounts for about one third of the UK's total greenhouse gas emissions. The Government Net Zero strategy has set a deadline of 2050 for reducing emissions to near zero. While some progress is being made in reducing road transport emissions, all transport sectors are under increasing pressure to show that they will be able to decarbonise in line with the UK's Carbon Budgets and Net Zero targets.

This is an independent report from the Association for Renewable Energy and Clean Technology (REA). It considers how a major UK transport hub could meet its share of these national Net Zero targets, focusing on Southampton and the Solent area. By examining these specific challenges and opportunities, this report recommends initiatives that may be applied more generally by policy makers to decarbonise other transport hubs across the UK.

Transport decarbonisation will require a mix of initiatives across the public and private sectors - switching to low carbon fuels, improving efficiency and reducing demand. For the developers of low-carbon transport infrastructure these themes pose major opportunities and challenges over the coming decade. For surface transport, advancements in smart charging, intelligent grid management, and financing models are all creating opportunities for affordable decarbonisation. Solutions are also becoming available beyond road transport, including in the marine, aviation, and rail sectors. All these need to be included in an integrated decarbonisation strategy.

As a major transport hub, Southampton and the Solent business community already have plans to exploit decarbonisation opportunities and seek economic growth. For example, the Solent maritime sector currently contributes around £6 billion of GVA (Gross Value Added) per annum, around 20% of the Solent economy. This could increase by £2 billion per annum through forecast shipping volume growth. But if progress is not made in transport decarbonisation, there is both a risk that this economic growth potential is lost and Net Zero targets are missed.

This report considers that a major gap remains between these ambitions and the practical deployment of the necessary new decarbonisation infrastructure and technologies. Southampton and the Solent area, with major port, airport, rail, and road transport links, has developed a transport strategy with clear targets. Yet it lacks a clear roadmap of what the scope of relevant infrastructure might look like, how deployment would be managed and co-ordinated, or how it might be financed.

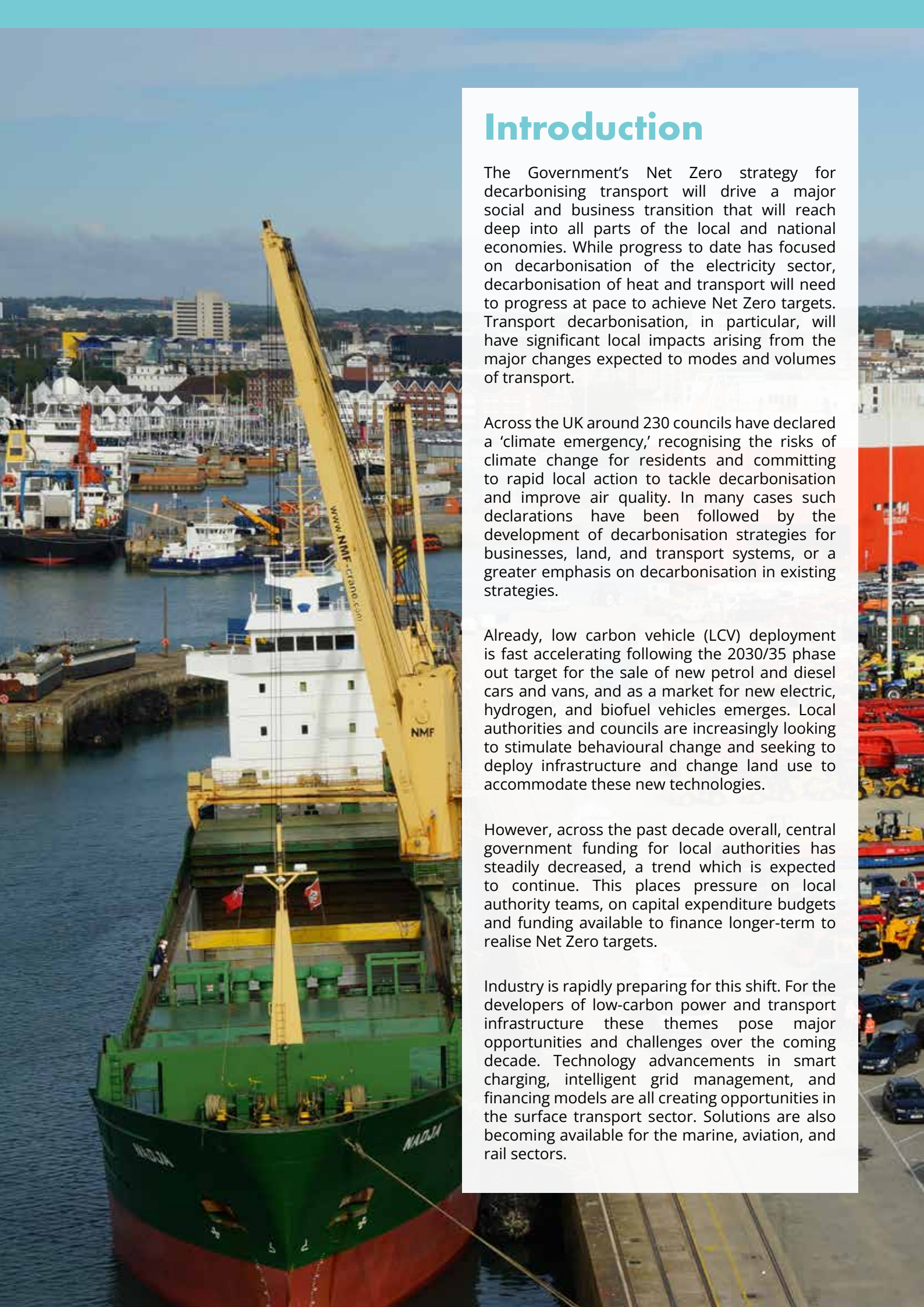
We recommend three key initiatives that should be pursued to achieve local transport decarbonisation. These are:

1. Integrated transport decarbonisation plans – local strategies and action plans for transport decarbonisation must be prepared and form part of integrated whole energy system decarbonisation plans. They should 'join the dots' between individual plans developed by local authorities, central government, businesses, utilities, and other key stakeholders. Effective planning and co-ordination will be critical for optimising initiatives and ensuring affordable decarbonisation.

2. Accountable governance for planning and delivery – accountability should be vested in local authorities to ensure that integrated transport plans are developed, updated, and delivered. This might include appointment of a specialist whole energy system design authority, or transport delivery authority.

3. Enabling transport technology and infrastructure investment – enabling early, 'no-regrets' investment in technology and infrastructure. Specific projects should be targeted, utilising the appropriate public or private led financing models.

Decarbonisation of transport presents a major challenge but also a great opportunity. While this report has used the Southampton and Solent Transport Hub as an example, the recommendations are relevant UK-wide. Delivery of these recommendations will require action by national and local policy makers, businesses, and other key stakeholders.



Introduction

The Government's Net Zero strategy for decarbonising transport will drive a major social and business transition that will reach deep into all parts of the local and national economies. While progress to date has focused on decarbonisation of the electricity sector, decarbonisation of heat and transport will need to progress at pace to achieve Net Zero targets. Transport decarbonisation, in particular, will have significant local impacts arising from the major changes expected to modes and volumes of transport.

Across the UK around 230 councils have declared a 'climate emergency,' recognising the risks of climate change for residents and committing to rapid local action to tackle decarbonisation and improve air quality. In many cases such declarations have been followed by the development of decarbonisation strategies for businesses, land, and transport systems, or a greater emphasis on decarbonisation in existing strategies.

Already, low carbon vehicle (LCV) deployment is fast accelerating following the 2030/35 phase out target for the sale of new petrol and diesel cars and vans, and as a market for new electric, hydrogen, and biofuel vehicles emerges. Local authorities and councils are increasingly looking to stimulate behavioural change and seeking to deploy infrastructure and change land use to accommodate these new technologies.

However, across the past decade overall, central government funding for local authorities has steadily decreased, a trend which is expected to continue. This places pressure on local authority teams, on capital expenditure budgets and funding available to finance longer-term to realise Net Zero targets.

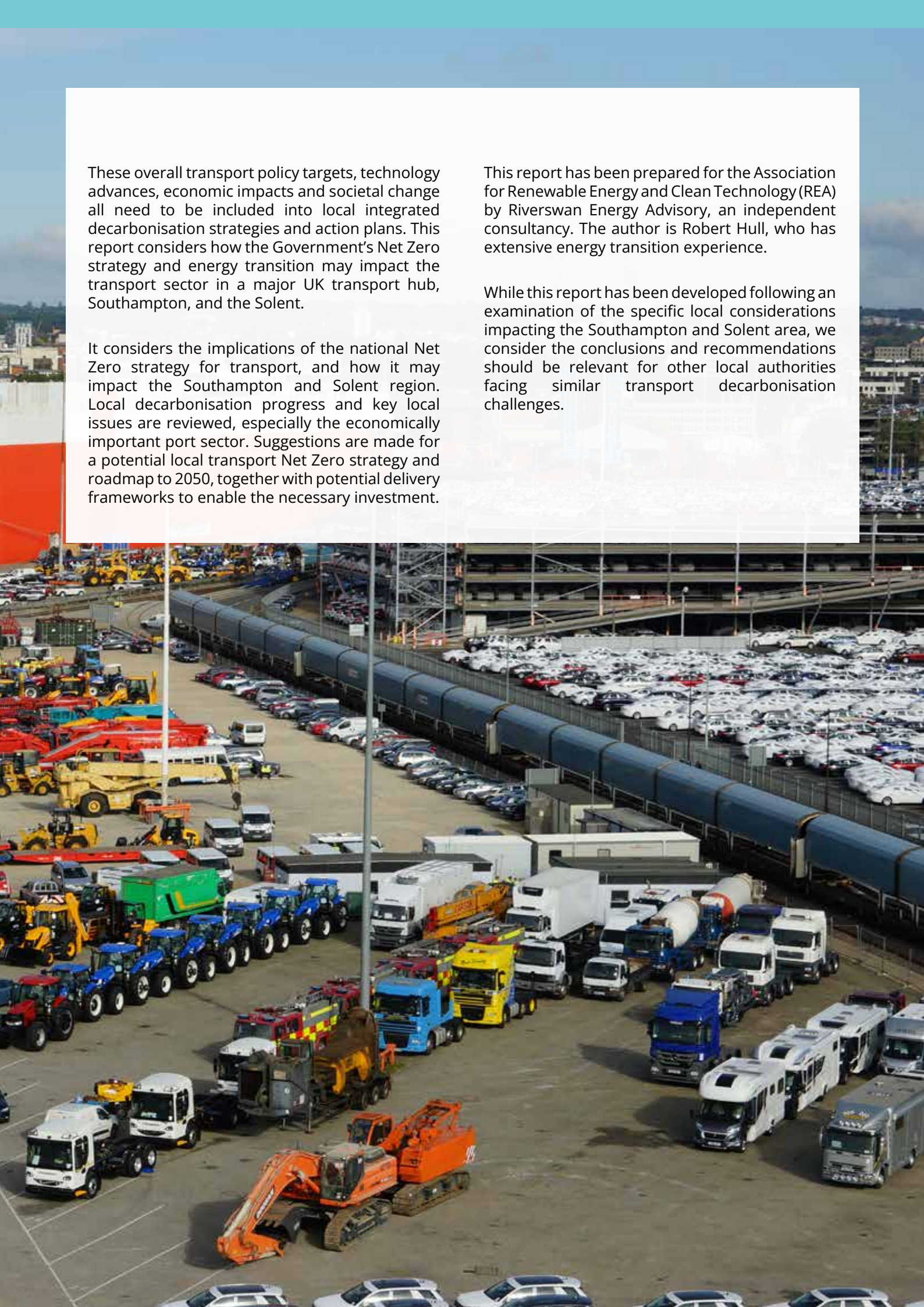
Industry is rapidly preparing for this shift. For the developers of low-carbon power and transport infrastructure these themes pose major opportunities and challenges over the coming decade. Technology advancements in smart charging, intelligent grid management, and financing models are all creating opportunities in the surface transport sector. Solutions are also becoming available for the marine, aviation, and rail sectors.

These overall transport policy targets, technology advances, economic impacts and societal change all need to be included into local integrated decarbonisation strategies and action plans. This report considers how the Government's Net Zero strategy and energy transition may impact the transport sector in a major UK transport hub, Southampton, and the Solent.

It considers the implications of the national Net Zero strategy for transport, and how it may impact the Southampton and Solent region. Local decarbonisation progress and key local issues are reviewed, especially the economically important port sector. Suggestions are made for a potential local transport Net Zero strategy and roadmap to 2050, together with potential delivery frameworks to enable the necessary investment.

This report has been prepared for the Association for Renewable Energy and Clean Technology (REA) by Riverswan Energy Advisory, an independent consultancy. The author is Robert Hull, who has extensive energy transition experience.

While this report has been developed following an examination of the specific local considerations impacting the Southampton and Solent area, we consider the conclusions and recommendations should be relevant for other local authorities facing similar transport decarbonisation challenges.



2. The UK's Net Zero Transport Challenge

The transport sector, covering surface transport, aviation, and shipping, currently accounts for about one third of the UK's overall greenhouse gas emissions. Rapid progress will need to be made in this sector if 2050 Net Zero decarbonisation target is to be achieved.

Climate Change Committee Net Zero recommendations

The UK Climate Change Committee (CCC) quantified the challenge for the UK in its 6th Carbon Budget (for the years 2033-37) report[1] to Government in 2020. Their recommended pathway requires a 78% reduction in UK territorial emissions[2] between 1990 and 2035 to reach Net Zero by 2050. Meeting the budget requires average annual reductions in UK emissions of 21 $MtCO_2e$, similar to the profile achieved in the UK since 2012.

The CCC recommended that a 'Balanced Net Zero Pathway' scenario be applied such that the UK take a global leadership role to limit global warming below 1.5°C. They recommended four key actions:

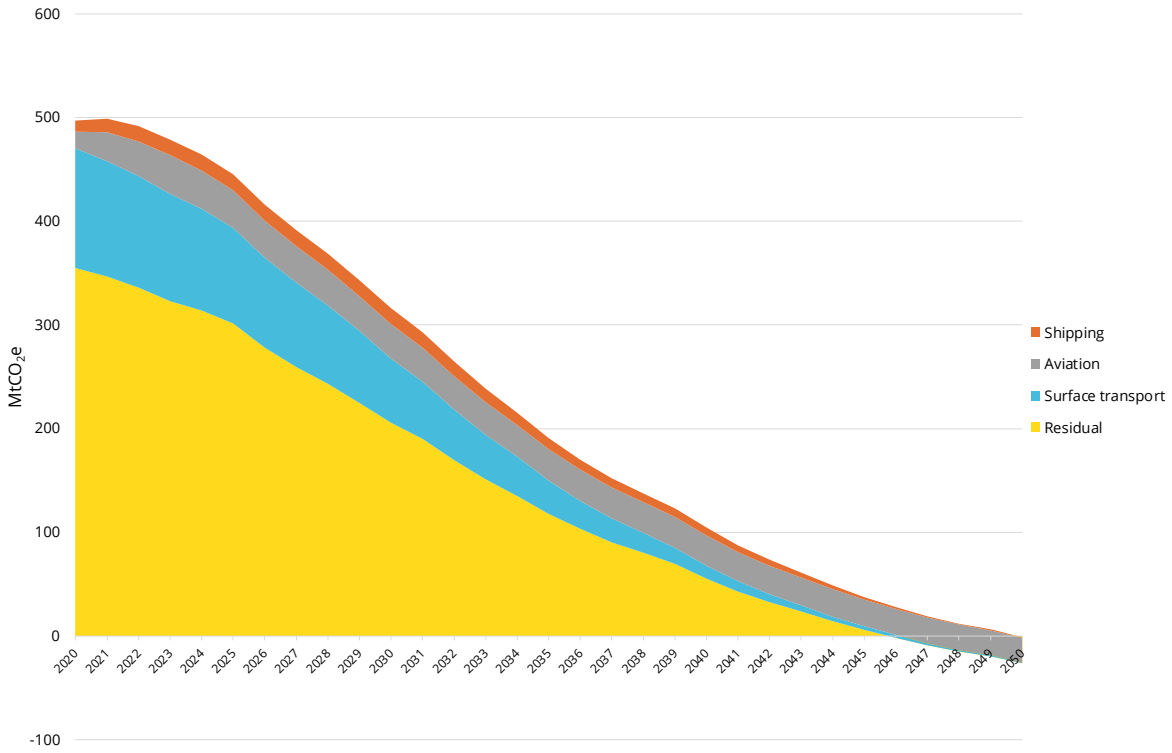
- Reducing demand for carbon intensive activities e.g., from improved vehicle efficiency, and reduced travel demand
- Take up of low carbon solutions e.g., electric vehicles
- Expanding low carbon energy supplies including renewable electricity and hydrogen
- Land use transformation, included low carbon farming practices, and bioenergy

The CCC also recommended that the Government prepare a Net Zero strategy to achieve its Net Zero target.

Turning to implications for transport, the following chart shows the CCC recommendations for overall CO_2 emissions reduction of some 500 $MtCO_2e$ between 2020 and 2050, and specifically the contribution expected from the transport sectors of surface transport, shipping, and aviation.

Figure 1: Overall CO_2 Emissions – CCC 2050 Balanced Pathway to Net Zero

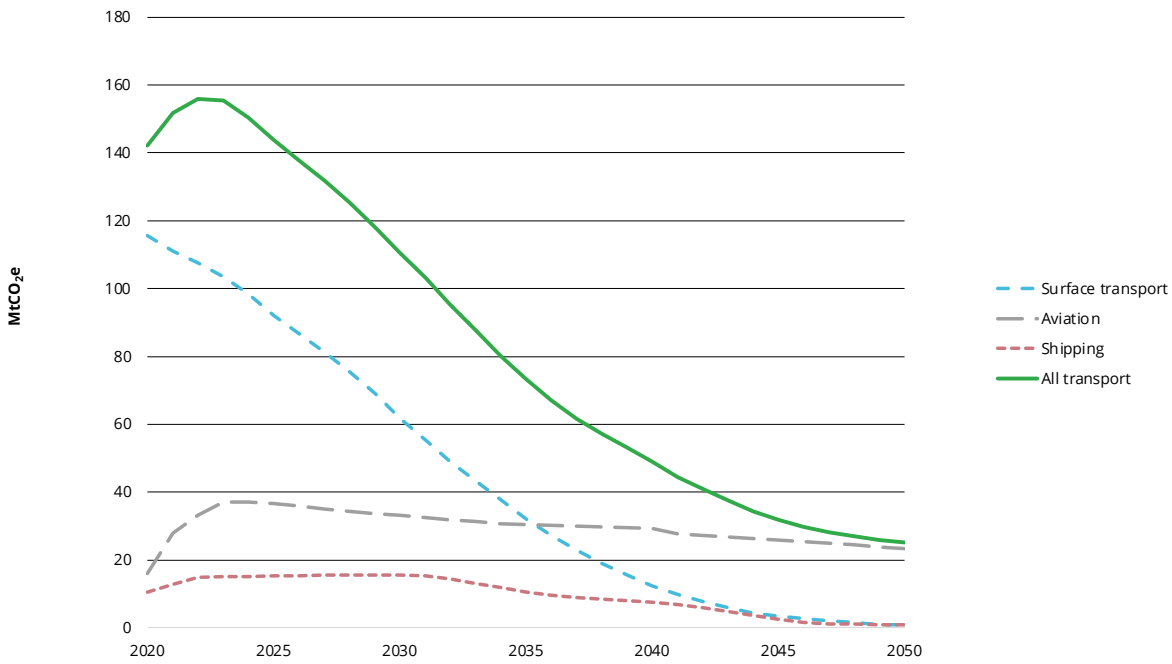
CCC Balanced pathway to 2050



Surface transport comprises 22% of 2019 emissions and an early reduction in emissions is recommended by 2035. Aviation comprises 7% of 2019 emissions and shipping comprises 3%.

The CCC's recommended emissions reduction profiles for the three transport sectors are shown in the following chart and key features of each are described below.

Figure 2: Transport CO² Emissions – CCC 2050 Balanced Net Zero Pathway



Surface transport

In 2019, these emissions comprised 113 $MtCO_2e$ or 23% of total UK emissions. The chart shows that surface transport (road and rail) emissions decrease by about 70% between 2020 and 2035 before falling to just $1MtCO_2e$ by 2050.

The key assumptions are that there is a rapid take up of electric vehicles over the next decade, associated with an overall reduction in car travel (about 17% of car miles by 2050). There should also be a transition to zero carbon trains, buses, and heavy goods vehicles.

The CCC forecast that the overall domestic investment for decarbonisation of surface transport would reach about £10 billion per annum by 2025 and continue at that level until 2050, totalling over £250 billion. This includes both public investments e.g., public charging infrastructure and private investment e.g., for the purchase of vehicles.

Aviation

The Balanced Net Zero Pathway scenario assumes the aviation sector returns to pre-pandemic levels by 2024. Thereafter emissions decline over time to reach $23MtCO_2e$/year by 2050. These residual emissions are expected to be offset by initiatives for removal of greenhouse gases.

The scenario assumes that demand growth is limited to 25% growth from 2018 levels compared to an unconstrained growth of 65%. It is assumed that fuel efficiency is improved, and there is greater use of sustainable aviation fuels (split between biofuels and synthetic jet fuel).

The CCC forecast for investment in the aviation sector to realise Net Zero is around £12 billion but only around 5% of these are expected to be domestic investments, with the remainder being international sustainable fuel investments.

Shipping

The Balanced Net Zero Pathway assumes the shipping sector returns to pre-pandemic levels in 2022, then emissions hold flat until 2030, then decline to near zero by 2050.

The scenario assumes that the emissions reductions from 2030 are mainly (87%) derived from a switch to low carbon fuels such as ammonia and the remainder from an increase in electricity used for shore power and propulsion and efficiency improvements.

The CCC forecast for investment in the shipping sector to achieve Net Zero targets is around £150m a year from 2032 and around £600m per year from 2032, totalling some £12 billion. About two thirds of this expenditure or £8 billion is expected to be domestic electrification and ammonia production, and the remainder mainly from international ammonia production.

Government Net Zero Strategy

In October 2021, the Government published its Net Zero Strategy[3] and policies to achieve Net Zero targets for each emissions sector. It stated:

> "Our strategy for net zero is to lead the world in ending our contribution to climate change, while turning this mission into the greatest opportunity for jobs and prosperity for our country since the industrial revolution."

Plans were set out to achieve the delivery pathway to 2037, and ultimately the 2050 target. In its subsequent review of the strategy[4] the CCC agreed it largely aligns with their analysis and recommendations. The strategy will require major changes to energy supply and consumption across all sectors of the economy.

Turning to transport, the Government's plan proposed to mobilise additional public and private investment of around £220 billion. The key transport policies were:

- Targets and policies to enable zero emission road transport and supporting infrastructure with all cars to be zero emissions capable by 2035, and a ban on the sale of new petrol and diesel cars by 2030.
- £600m of funding for zero emission vehicles and infrastructure including local EV infrastructure, and an additional £350m added to the £1 billion Automotive Transformation Fund to support the industry transition.
- £2 billion investment which will help enable half of journeys in towns and cities to be cycled or walked by 2030.
- £3 billion to create integrated bus networks, more frequent services and bus lanes to speed journeys.
- Transformation of local transport systems, with 4,000 new zero emission buses and the infrastructure to support them, and a net zero rail network by 2050, with the ambition to remove all diesel-only trains by 2040.
- Significant investment in rail electrification and city rapid transit systems.
- Delivering real-world demonstrations and technology trials of clean maritime vessels and infrastructure to decarbonise the maritime sector.
- Aim to become a world-leader in zero emission flight and kick-starting the commercialisation of the UK sustainable aviation fuels with a target of 10% by 2030.

In addition, there were also a range of policies to mobilise additional public and private investment in the development of cleaner fuels such as hydrogen and biofuels. Alongside the overall Net Zero transport strategy, many detailed policy initiatives are also set out in the Government's 2021 Decarbonising Transport Plan[5] applying to each of the transport sectors. These are summarised below:

Surface transport

Surface transport is currently the largest emitting sector of the UK economy but emissions from this sector have been broadly flat over the past decade, falling just 1% between 2009 and 2019. They need to fall dramatically by 2050 to meet the economy-wide Net Zero target.

The Government vision is for a fundamental change, with transport use reduced through greater walking and cycling and greater use of public transport, especially buses. All non-zero emission road vehicles, including cars, vans, buses, and heavy goods vehicles, should be phased out by 2040. Railways will be decarbonised through further electrification together with the use of battery and hydrogen trains.

Aviation

The Government wishes to accelerate aviation decarbonisation in a way that preserves the benefits of air travel and maximises the opportunities from decarbonisation. While aviation only contributes about 2-3% of greenhouse gas emissions at present, it is forecast to become the second highest residual emitter by 2050 as petroleum continues to be used as the primary aviation fuel.

Their 2021 'Jet Zero' consultation is proposing policies to improve the efficiency of the aviation system, to set targets for UK domestic aviation and airport ground operations decarbonisation by 2040, together with initiatives to support the commercialisation of sustainable aircraft fuels. This may include a sustainable aviation fuel mandate.

In the aviation sector, aircraft themselves represent one of the most challenging technologies to decarbonise. However, airport ground operation, including transport and ancillary services offer greater potential for other low carbon technologies to be deployed.

Shipping

The Government's vision is for the UK to play an important role in developing zero emission maritime technology, such as alternative fuel powered vessels using ammonia or methanol produced from low carbon hydrogen, or highly efficient batteries, and maximising the opportunities from these developments.

In its 2019 Clean Maritime Plan - Maritime 2050: navigating the future[6], the Government set out its roadmap for the future of zero emission shipping. It proposed that by 2025 all vessels operating in UK waters should maximise the use of energy efficiency, and that new vessels being ordered for use in UK waters should be designed with zero emission propulsion capability. Furthermore, by 2035 there would be a number of clean maritime clusters. focused on innovation and infrastructure associated with zero emission propulsion technologies, including bunkering of low or zero emission fuel.

The 2021 Net Zero strategy proposes that targets for 2030 and to realise Net Zero for the UK domestic maritime sector will be set after public consultation in 2022. The consultation will address the potential phase-out date for the sale of new non-zero emission domestic vessels, and how economic mechanisms may be used to accelerate decarbonisation.

The Government also plans to extend the Renewable Transport Fuel Obligation to the maritime sector, incentivising the use of renewable fuels, and to support and, if needed, mandate the uptake of shore power in the UK both for vessels and ports. Funding is also proposed to support the development of zero emission technology and infrastructure.

The maritime sector faces a major decarbonisation challenge from the need to transition the forms of vessel propulsion. However, similar to aviation, there is a significant opportunity to decarbonise the shore based equipment, including for example, electrification of shore power, cranes, and other ancillary equipment.

The transport decarbonisation challenge – how to deliver it?

The Government's Net Zero transport targets and policy initiatives described above represent a radical reform affecting all elements of the transport value chain, from energy supply to transport operation to customer behaviour. And the pace of change is significant, with the transition needed over the next decade – and given the long-term nature of most transport infrastructure, that means that planning and investing for the transport transition must begin now.

It is a critical issue - the UK is a major global trading hub and efficient, effective, international transport is critical to the national economy. But transport is also a very local issue, fundamental to local businesses, communities, and people's everyday lives. The investment required to transition to a decarbonised transport system is significant and will need to be mobilised and funded in the most efficient way.

We have described the targets and policy initiatives at a national level, but to try and consider the practical challenges and opportunities that could apply to a major UK transport hub, we have examined the implications for transport decarbonisation in the Southampton and Solent region.

3. Southampton and the Solent – transport decarbonisation plans

The context and decarbonisation plans

Southampton is a major UK hub for sea, air, and surface transport, located on England's south coast. It has a population of 254,000 and its key transport characteristics (in 2019) are:

- Maritime - Port: 1.8m cruise ship passengers (85% of UK total) and 35m tonnes of freight per annum; Isle of Wight ferries
- Aviation - Airport: 1.8m passengers per annum
- Surface transport - Road and rail networks providing national and local connections to the city, port and airport

Southampton is also part of the Solent area of eight local authorities, with a population of more than 1.25 million and over 42,000 businesses. It is an economic hub encompassing the two cities of Southampton and Portsmouth, the Isle of Wight, the New Forest, the M27 corridor and the Solent waterway. It is a gateway to European and global markets, with direct road and rail links to London, and international connections through an airport and two ports, which lie just 20 miles from the world's busiest shipping route from Shanghai to Rotterdam.

The 2021 Spring Budget announced that the Solent would be one of eight UK Freeport locations, enabling businesses to benefit from reduced tax and tariffs. Authority and Solent economic area is shown in the diagram below.

Southampton City and Solent decarbonisation plans

Greener City Plan 2030[7] - In 2019, Southampton City Council declared a climate emergency. Their Greener City Plan 2030 commits to the council's buildings being Net Zero by 2030, that 90% of the council vehicle fleet will be zero emission by 2030, and to work with partners to deliver the infrastructure for a zero-emission public transport system by 2030, including an increase in cycling.

Connected Southampton 2040[8] - In 2019, the Southampton City Council published its Local Transport Plan to outline its strategy for managing and delivering transport in the future. The main goals were to improve transport to support economic growth, to improve access to transport, and encourage 'active travel'. The ambition anticipated a population increase of 30,000 by 2040, accompanied a doubling of port and airport throughput by 2035-37. The key initiatives mainly related to surface transport and were:

- Active Travel Zones in the City centre and local neighbourhoods to encourage people to walk and cycle for short trips, discouraging through traffic, a network of Park & Ride and a comprehensive Cycle Network;
- Reduced emissions from traffic by supporting alternative fuels and intelligent management of traffic; and
- Better transport connectivity, enabling the growth of the main employment areas in Southampton.

The Solent region

Powering the Solent[9] - also in 2019, the Solent Local Enterprise Partnership (LEP) produced a Heat and Power Strategy and Action Plan to 2050. This was prepared in response to an invitation from BEIS for LEPs to help develop regional energy development programmes. Overall, the Solent region energy consumption totalled some 43 TWh, split between industrial and commercial (50%), domestic (26%), and transport (24%).

The plan outlined a strategy for the Ports of Southampton and Portsmouth to seek economic growth and value creation opportunities from port and vessel decarbonisation, together with smart port technology to boost productivity. For surface transport a strategy for deployment of EV charging infrastructure and an integrated mass transit system was proposed. Key enablers were identified as the need for electric vehicle charging infrastructure and significant grid capacity to accommodate the electrification of transport.

Economic impact of the Solent Maritime sector - the Solent ports of Southampton and Portsmouth provide a major international gateway for trade in goods and in passenger movements, both inbound tourists and cruise passengers. In analysis performed in 2015, the Solent maritime sector was estimated[10] to contribute about £6 billion of GVA to the £31 billion GVA for the region, representing around 20% of the Solent economy.

In May 2021, the Solent LEP produced a post pandemic recovery plan[11] , building on the strong maritime capabilities in the region. The recovery strategy included initiatives to foster innovation and boost regional growth, and to pursue maritime decarbonisation priorities.

The action plan for maritime decarbonisation included pioneering the introduction of 'shore power' technology in the Port of Southampton, to become the first UK port to deliver shore power for large commercial vessels, and to work with Maritime UK to develop a 'Greenprint' for marine and maritime led decarbonisation in the Solent.

UK industrial decarbonisation strategy[12] - In March 2021, the Government launched a strategy and roadmap for industrial decarbonisation in line with Net Zero. The ambition was for emissions to reduce by two thirds by 2035 and 90% by 2050, mainly by switching to low carbon fuels, although some emissions would be captured through Carbon Capture, Usage and Storage (CCUS).

The strategy identified the UK's six largest industrial clusters by level of CO_2 emitted – Southampton was identified as the sixth largest emitting area, with annual emissions of 3.2MtCO^2e, primarily due to oil refining activities. The Government's aim is to work with industry and local communities to decarbonise these clusters.

In December 2021, local gas distribution company SGN, Macquarie's Green Investment Group and ExxonMobil announced a joint project to explore the use of hydrogen and carbon capture to help reduce emissions in the Southampton industrial cluster. While this initiative is not directly transport related, it has the potential for enabling hydrogen energy resources which may also be available for use in the transport sector.

What is the decarbonisation challenge for Southampton and the Solent?

Government targets and policies for decarbonisation will cause a dramatic change in the future energy mix in the City and region. To illustrate this, we have compared the overall actual energy consumption in Southampton Local Authority Area in 2019 with a Net Zero scenario for 2050. This includes all energy use, across power, heat and transport sectors. 2019 is used as the base year to avoid temporary demand reductions during the pandemic.

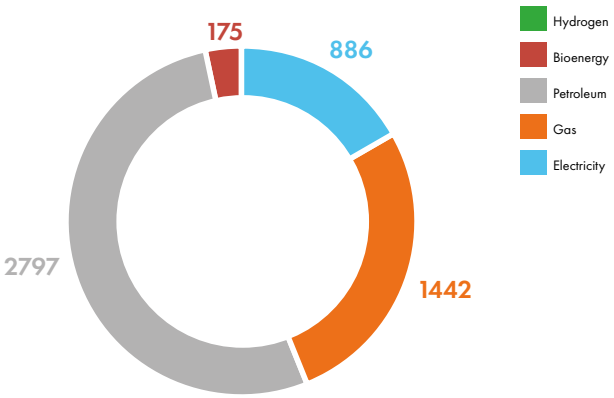
The 2050 Net Zero scenario for Southampton is based on the national scenarios used in the CCC Balanced Pathway scenario. Further detail on data sources used for 2019 data and how the 2050 energy forecasts have been derived are included in Annex 1.

The following chart shows GWh of total energy consumption within the Southampton Local Authority area in 2019. It illustrates the equivalent energy consumption in 2050 if Southampton is to achieve Net Zero, in line with the CCC Balanced Pathway assumptions.

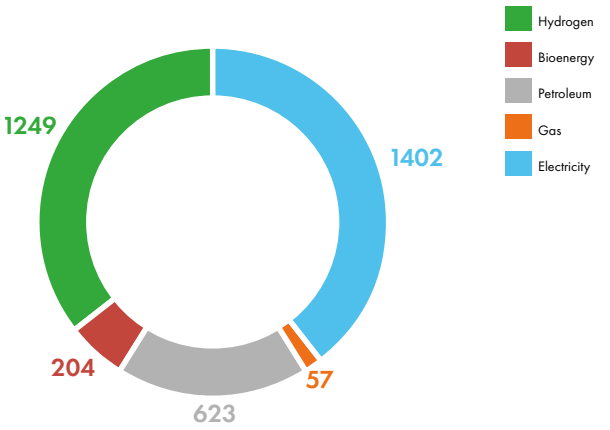
Figure 4: Potential Southampton local authority energy consumption – 2019 to 2050

Source: REA research based on CCC 6th Carbon Budget, Balanced Pathway model, used to meet Net Zero targets by 2050.

2019 Energy Demand - 5.3 GWh



2050 Energy Demand - 3.5 GWh



The diagram shows total energy demand in 2019 was 5.3GWh and the equivalent in 2050 is estimated to reduce to 3.5GWh. By 2050, this suggests that natural gas use is almost eliminated, being replaced by hydrogen and electricity. However, this overall decrease in energy use also includes significant potential increases in maritime and aviation traffic, contributing significant benefits to the local economy.

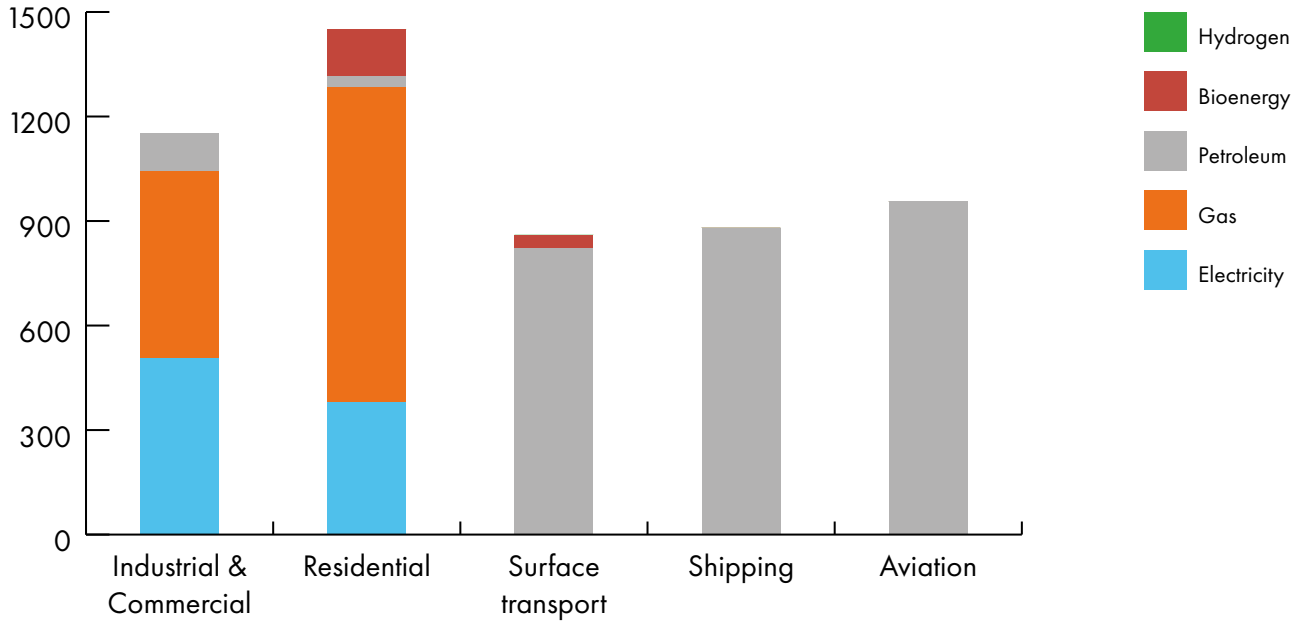
Petroleum use is greatly reduced, with the residual amount largely being used for aviation fuel. Gas is largely replaced by electricity and there is a significant increase in hydrogen, with around three quarters of this expected to be in the form of ammonia being used for shipping propulsion.

The following charts provide a more detailed breakdown of the potential changes from applying this CCC national scenario to local energy demand. The volumes shown also reflect the significantly higher proportion of transport energy use in the Southampton area.

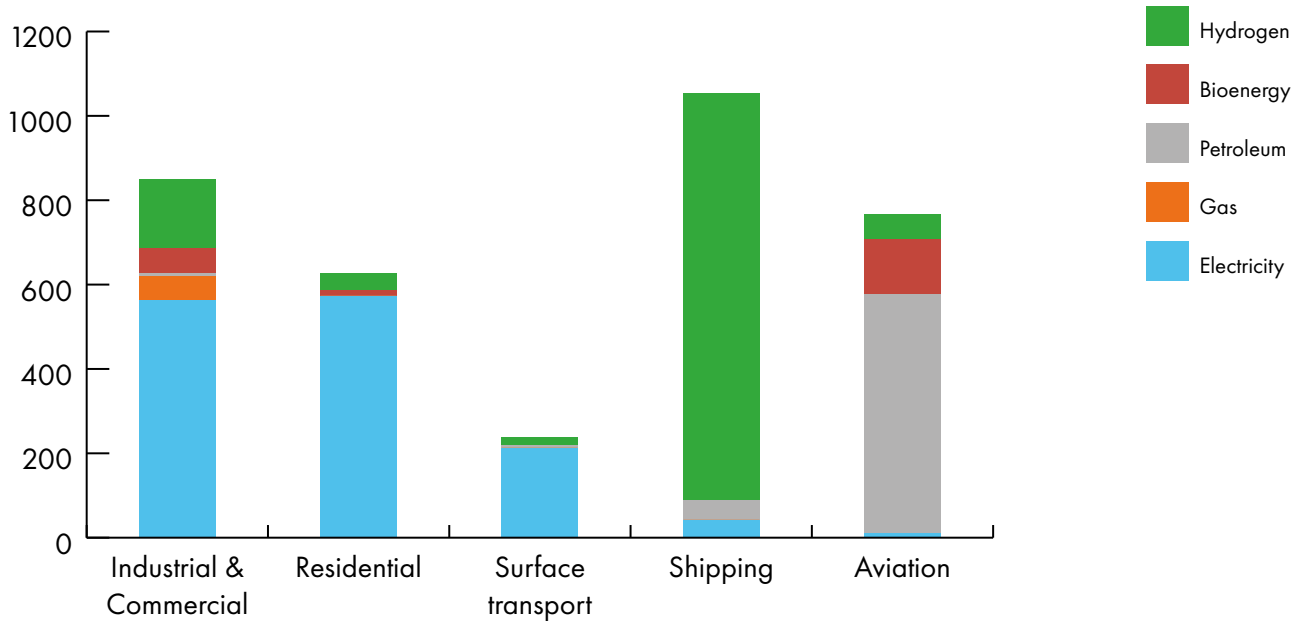
Figure 5: Potential Southampton energy consumption (GWh) - 2019 to 2050

Source: REA research based on CCC 6th Carbon Budget, Balanced Pathway model, used to meet Net Zero targets by 2050.

Southampton Energy Demand 2019



Southampton Energy Demand 2050



The overall decrease in energy consumption by 2050 is due to lower forecast residential and industrial & commercial energy demand, primarily due to increases in energy efficiency. Surface transport demand shows the largest decrease as travel miles are expected to reduce alongside improvements in vehicle efficiency. This scenario proposes a dramatic reduction in road transport use which will be challenging to realise. If this cannot be realised, then other

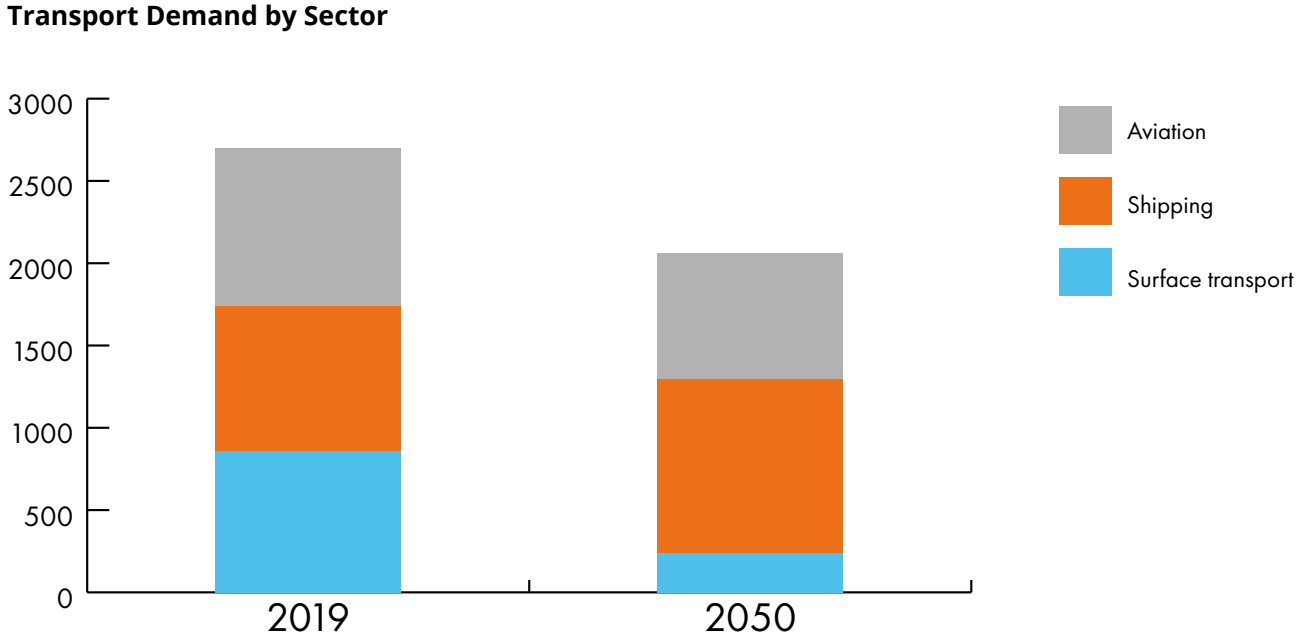
forms of emission reductions will be needed to compensate for potential shortfalls. By contrast, the shipping and aviation sectors are expected to grow, with a commensurate increase in energy demand, but offset by efficiency savings.

However delivery of this transition will not be straightforward. For example, the phasing out of natural gas for heating is a significant logistical, economic, and social challenge, as will be the transition to electric vehicles and active transport. Also, additional population and business growth will drive additional energy demand, including for transport.

Looking specifically at the transport sector, the changes outlined in the chart below (Figure 6) result from this scenario.

Figure 6: Southampton transport sector energy consumption (GWh)

Source: REA research based on CCC 6th Carbon Budget, Balanced Pathway model, used to meet Net Zero targets by 2050.



To achieve the CCC Balanced Net Zero Pathway profile in Southampton, the most dramatic reduction would be in energy use for surface transport, where vehicle electrification, increased public transport, and active travel will all play a major role. Shipping energy use is expected to increase, but this will need to be accompanied by major carbon reductions. Aviation is less impacted by this decarbonisation pathway, although the assumptions include the growth of sustainable fuels and electric aircraft.

It is important to note that the above scenarios are purely illustrative and represent a top-down view on the potential energy transition for Southampton based on the CCC Balanced Pathway scenario. They may not be the most effective way of achieving Net Zero, but they should help to show the transport decarbonisation challenges facing Southampton and the Solent area.

4. Southampton and the Solent - transport pathways to Net Zero

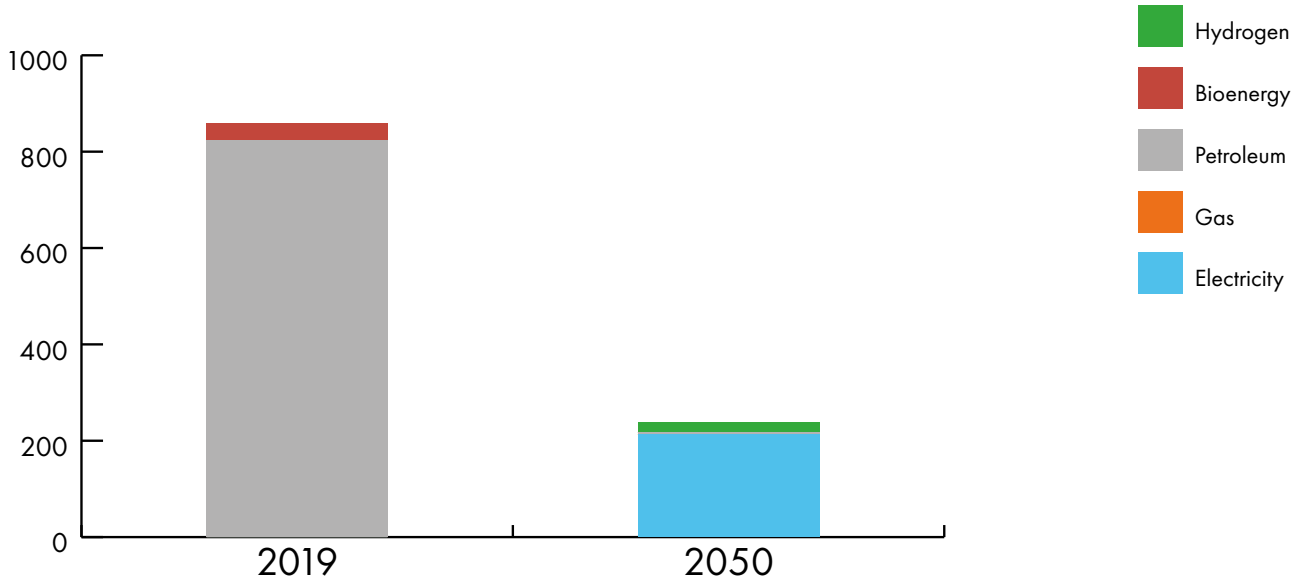
We have examined the potential decarbonisation pathways for the three transport sectors.

Surface transport

Using the CCC Balanced Pathway scenario, Southampton's surface transport pathways to Net Zero will require reducing emissions to near zero. It will need a combination of behavioural change to reduce or change demand for travel, efficiency improvements to fossil fuel vehicles and the introduction and uptake of zero-emission vehicles. The following chart illustrates the potential change in demand and fuel type between 2019 and 2050.

Figure 7: CCC Projections for Surface transport, Southampton (GWh)

Source: REA research based on CCC 6th Carbon Budget, Balanced Pathway model, used to meet Net Zero targets by 2050.

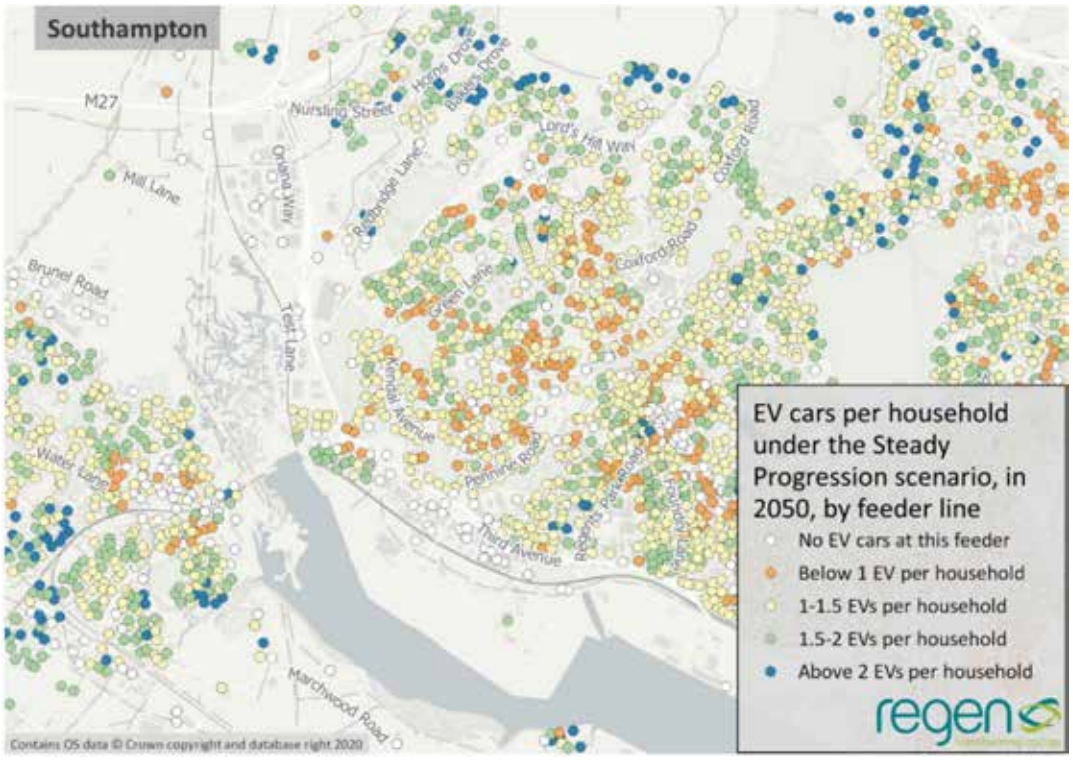


The main surface transport decarbonisation pathways are expected to include:

- Electric vehicles, including EV charging point expansion and encouragement of EV use
- Increase mass transit, including buses
- Boost active transport, including cycling, walking and car-sharing
- Rail electrification

As shown above, surface transport is mainly expected to transition to electricity. The following diagram is taken from the Scottish and Southern Electricity Networks (SSEN) electricity distribution network future energy scenarios 2020[13]. It shows how their network might need to connect EV's in Southampton by 2050, noting that the EV penetration in city homes may be relatively low because alternative forms of transportation may be readily available.

Figure 8: SSEN 2020 DFES scenario of EV penetration in Southampton City



Reproduced by kind permission of SSEN and Regen, (source: https://www.ssen.co.uk/globalassets/about-us/dso/ssen-dfes-2020---methodology-and-results-companion-report-for-southernengland-licence-area-signed-2.pdf)

Overall, the implementation measures proposed by the CCC pathway appear consistent with the Southampton City 2040 transport plan for reduced vehicle use, introduction of mass transit, and electric vehicles. Southampton and the Solent could accelerate its existing plans for an integrated surface transport plan to target all of these aspects and enable delivery through a mix of public and private investment.

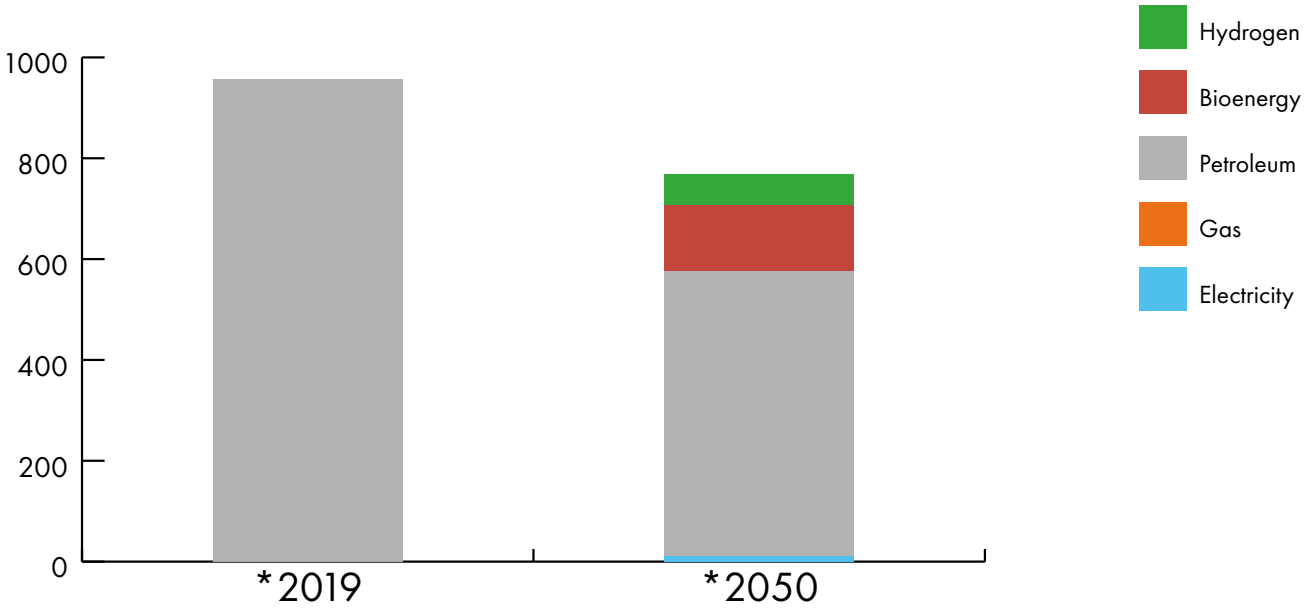
Delivering a reduction in transport demand, introducing alternative forms of transport, and electrifying the remaining surface vehicles will be challenging, given the dramatic decrease in energy use that is anticipated in this scenario. While the technology and initiatives to deliver this change are well understood, the main barriers are likely to be ones of cost and how to successfully realise behavioural change.

Aviation

Based on the CCC's Balanced Pathway scenario, aviation energy use remains relatively constant between 2019 and 2050, although there is an increased use of sustainable fuels and increases in traffic volumes are offset by efficiency improvements.

While noting that Southampton airport is in both Southampton and Eastleigh local authority areas, the following diagram suggests how the aviation energy transition might look if applied to the energy profile of Southampton local authority area. The energy demand has been based on the assumption that Southampton airport transports 0.6% of UK air passengers, and that it consumes 0.6% of UK aviation fuel as a result.

Figure 9: Aviation Energy Demand, Southampton (GWh)



The main aviation decarbonisation pathways are expected to include:

- Efficiency improvements to aircraft fuel consumption and utilisation
- Sustainable fuel use, including bioenergy and electricity (including production and storage)
- Decarbonisation of airports including ground operation, transport and ancillary equipment

The CCC's 2050 Balanced Pathway assumes that potential for increased passenger demand and energy use is capped by increased travel taxes or offset by more efficient aircraft fleets. Overall, a circa 20% expected increase in passenger volumes in expected to be offset by annual efficiency savings of 1-2%, resulting in a decline in aviation fuel use of about 20% between 2019 and 2050.

There is potential for alternative pathways to evolve for sustainable aviation fuels, including bioenergy or synthetic fuels. There is potential for Southampton and the Solent area to help enable the aviation transition through innovation and application of these efficiencies and sustainable fuels.

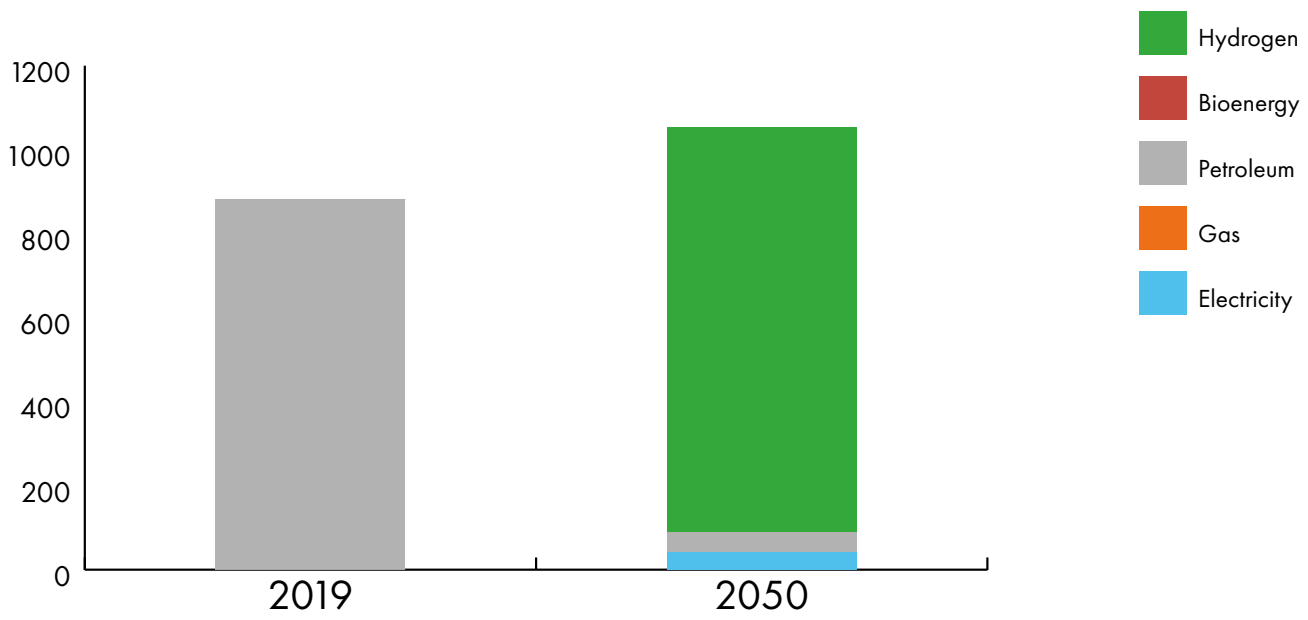
Shipping

The CCC pathway for shipping suggests that the overall UK energy use will decrease together with hydrogen (or ammonia produced from hydrogen) replacing petroleum. Overall, a circa 40% expected increase in shipping volumes by 2050 is expected to be offset by annual efficiency savings of around 1%, resulting in an increase in shipping fuel use of about 20% between 2019 and 2050.

This is shown below for Southampton shipping energy demand. The following figure illustrates this change, with a significant energy change from petroleum to ammonia derived from hydrogen.

Figure 10: Shipping Energy Demand, Southampton (GWh)

Source: REA research based on CCC 6th Carbon Budget, Balanced Pathway model, used to meet Net Zero targets by 2050.



The main marine decarbonisation pathways are expected to include:

- Shore side electricication including shore power, cranes and ancillary equipment
- Shore side propulsion charging
- Shore side sustainable fuel production (hydrogen, ammonia, methanol, etc,.). Green hydrogen could potentially be produced locally by electrolysis.
- Shore side sustainable fuel bunkering
    - The main emissions reduction options for the domestic and international shipping sectors are expected to be:
    - Fleet efficiency improvements, via a combination of operational optimisation, ship design and engine efficiency improvements, onboard renewable power generation (e.g., solar) and wind propulsion systems.
    - Electrification, to mainly provide shore power when vessels are docked in port and also used for some hybrid or full electric propulsion vessels (using onboard batteries and motors).
    - Zero-carbon emission fuels – the main alternatives appear to be ammonia, methanol, or hydrogen. Ammonia appears to have greater potential due to higher energy density than hydrogen (and therefore smaller on-board fuel tanks) and lower retrofitting costs. Ammonia production is expected to be cheaper than for methanol.

The key enablers for shipping decarbonisation will be the availability of shore power and low-carbon fuels. Given the prominence of the maritime sector in the Southampton and Solent economy, it would appear this should be a priority sector for decarbonisation. This could both enable the area to take a leadership role in developing new decarbonisation-led commercial opportunities, and also ameliorate the threat of competition from more-efficient, decarbonised transport hubs.

How can Southampton and the Solent become completely carbon free?

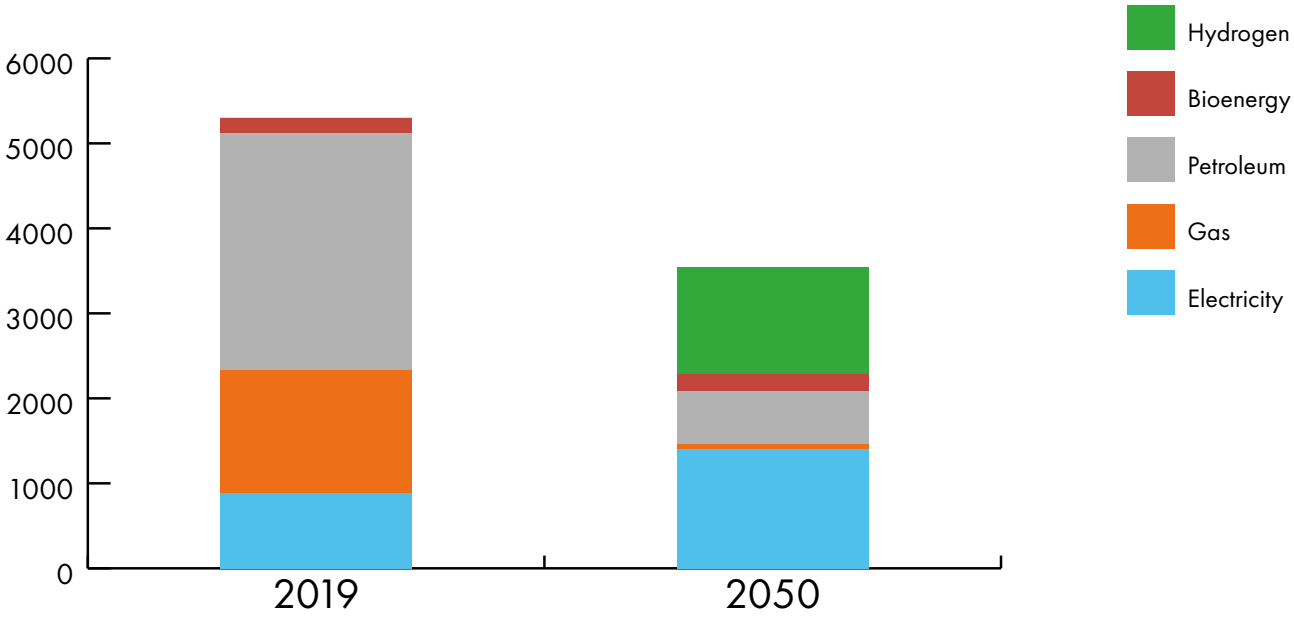
The above analysis shows that Southampton and the surrounding area faces a huge opportunity but also a significant challenge in reaching Net Zero. Industrial, commercial, and residential energy transition will need to deliver significant change, especially through electrification and decarbonisation of heating. The transport sector will need to provide a major contribution and especially the economically critical maritime sector.

The following figure shows the scale of the challenge:

Figure 11: Southampton energy demand by fuel type (GWh)

Source: REA research based on CCC 6th Carbon Budget, Balanced Pathway model, used to meet Net Zero targets by 2050.

Energy demand by fuel type

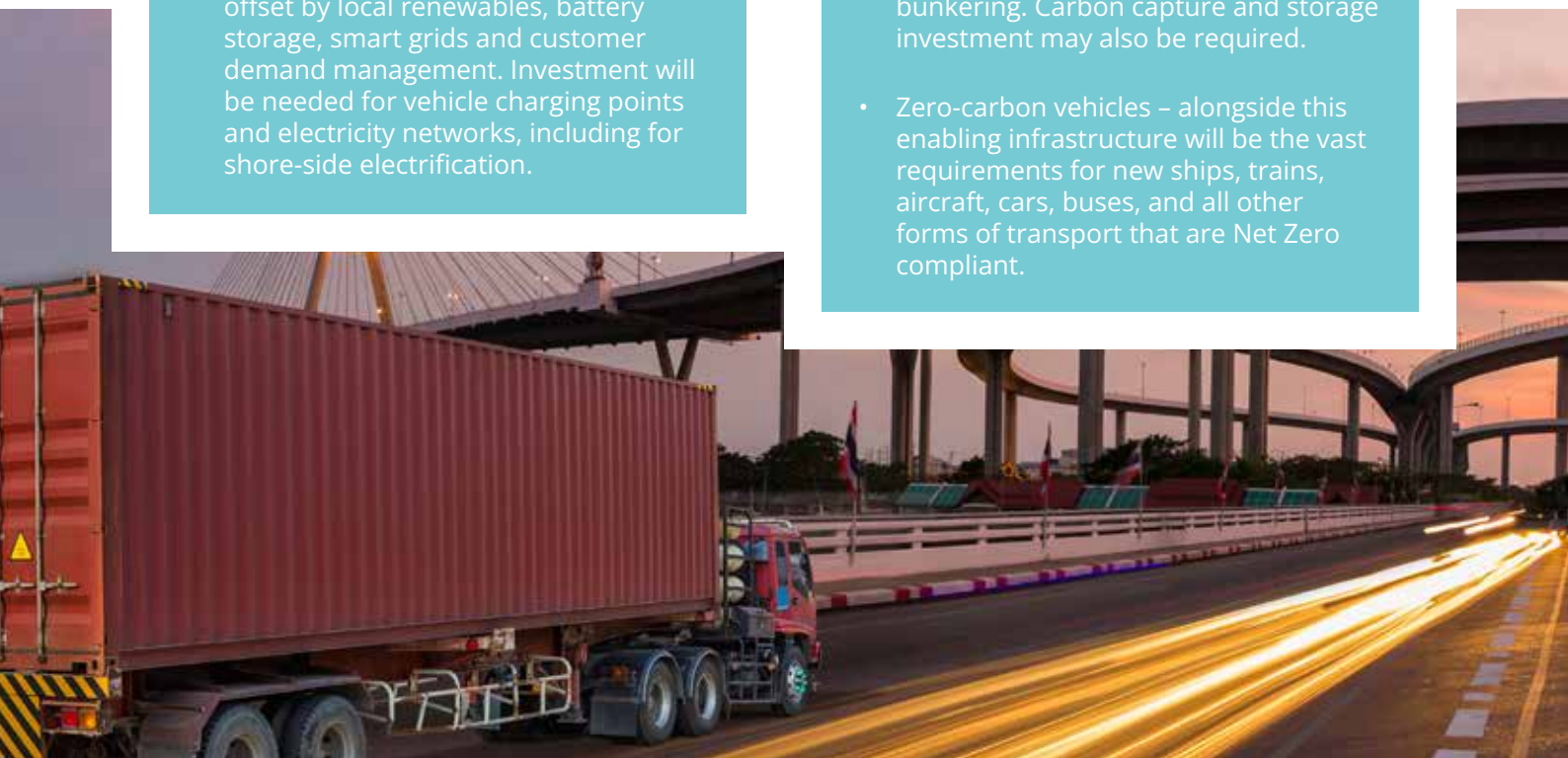


Delivering this change will need investment in the whole energy supply chain, including production and storage of new zero carbon energy, associated distribution infrastructure, and new equipment and devices to use it. The investment needs include:

- Electricity infrastructure - electricity demand will increase especially due to growth in heat pumps to replace gas boilers, electric vehicles, and possibly hydrogen electrolysers, but will be offset by local renewables, battery storage, smart grids and customer demand management. Investment will be needed for vehicle charging points and electricity networks, including for shore-side electrification.

- Zero-carbon fuel infrastructure – hydrogen and ammonia demand are expected to increase significantly. New facilities will be needed for production, transportation, and storage/ bunkering. Carbon capture and storage investment may also be required.

- Zero-carbon vehicles – alongside this enabling infrastructure will be the vast requirements for new ships, trains, aircraft, cars, buses, and all other forms of transport that are Net Zero compliant.



Alongside new investment needs, there are significant opportunities to gain efficiencies through better co-ordination. For example, the flexibility provided by electric vehicles and heating demand can reduce the amount of new electricity infrastructure that is needed.

While plans for some of these initiatives and funding will result from national policies, local authorities will also have a key role to play in implementation and particularly in coordination.

But there are significant barriers to realising this change and attracting the associated investment. From funding preparatory work to building delivery capabilities, to gaining public acceptance, planning and regulation, and assessing the economic impact, are all factors that will need to be addressed from local as well as national perspectives.

In this context, a local strategy and roadmap for delivery of a Net Zero ambition must seek to address the following:

- Local energy plan - create an integrated Southampton and Solent Net Zero energy plan, mapping out future energy demand and supply across electricity, heat, and transport
- Public engagement - public engagement and behaviour change plans to help citizens to take action to decarbonise energy sources, reduce energy demand and improve energy efficiency
- Transport – given the importance of Southampton and the Solent as a major transport hub, map out future supply and demand pathways across shipping, surface transport and aviation. Specific initiatives may include:
    - Ports – target accelerated deployment of Net Zero ports including early deployment of shore power.
    - Surface transport – target accelerated deployment of EV charging and EV deployment; demand reduction by enabling active travel; development of mass transit systems; acceleration of rail electrification
    - Innovation and skills – enabling of pilot projects and investment in capability building
- Electricity infrastructure – develop a detailed plan for short and longer-term infrastructure needs. This should include the development of private wire networks, behind the meter energy solutions, and intelligent, flexible grid solutions.
- Zero-carbon fuel infrastructure – examine options for zero carbon fuel production, distribution and storage; identify early no-regrets initiatives.
- Licensing and consenting - review planning and consenting processes to enable timely delivery of Net Zero infrastructure and associated applications
- Decarbonisation-led business opportunities – leveraging local expertise into business opportunities in the UK and internationally.

5. Potential delivery models

The transport transition to Net Zero will need to be supported by significant new infrastructure investment by public and private sectors including by regulated utilities. Decarbonisation policies from Government and funding commitments from regulator, Ofgem, should be sufficiently flexible to ensure that electricity and gas network companies can reinforce and adapt their infrastructure to support the new demands needed to deliver Net Zero transportation targets.

However investment will need to extend beyond these networks into customer and publicly owned infrastructure, to establish new shore power and ammonia supply facilities for example. Investment in this customer-focused infrastructure will need to be coordinated to ensure it is delivered and utilised in the most efficient way, for example by sharing capacity to reduce duplication and higher than necessary overall costs.

Local authority and industry collaboration and leadership will be important in delivering this investment efficiently and effectively. There are several alternative commercial delivery models to deliver the necessary integration, management and financing, which include:

1. **Local Authority solutions**
2. **Strategic delivery partner**
3. **Regulated utility solutions**
4. **Customer-led solutions**
5. **Energy supply company (ESCO)**
6. **Energy as a Service (EaaS)**

These are each discussed in more detail below, highlighting the key features of each solution together with their advantages and disadvantages. They present a range of potential delivery solutions, with the first three based primarily on top-down public sector design and funding of energy solutions, and the latter three based primarily of customer led solutions. All have advantages and disadvantages – but offer a choice to see which may work best in different situations.

These models are not mutually exclusive - the way forward may be to adopt several of these models as part of an overall delivery strategy.

1. Local Authority solutions

What is it? A delivery model where all solutions are designed and funded by the local authority, including infrastructure investment.

Advantages? Local Authority plans and owns the public infrastructure to serve current and future energy and transport needs.

Disadvantages? Local authorities must fund potentially large investment costs and funding may not be available from central government or council taxes. They may not have the necessary expertise. Performance and cost overrun risk remains with local authority. May lead to inefficient overall investment or delivery delays.

2. Strategic delivery partner

What is it? A delivery model where all solutions are provided to the local authority by a strategic delivery partner, including infrastructure investment. This could be an exclusive concession arrangement where a partner had long-term rights for energy solution delivery in a particular location.

Advantages? The strategic partner builds and owns the infrastructure to meet concession requirements, including the flexibility to meet changing customer requirements. Performance risk lies with the strategic partner.

Disadvantages? Funding may not be available from central government or local authorities. Concession contracts would need to be flexible so performance and cost overrun risk may remain with local authority. The concession would need to be managed by the local authority who may not have the necessary expertise. May lead to inefficient overall investment or delivery delays.

3. Regulated private utility solutions

What is it? A delivery model where the energy transition investment is delivered by a privately owned regulated utility such as an electricity or gas distribution network. They are funded by network charges socialised across all local customers.

Advantages? Customers benefit from more capital costs being funded by a regulated utility. Allows long-term central plan to be developed. Allows infrastructure to be developed to serve many customers, thereby sharing costs and enabling efficiencies. Performance risk lies with the utility.

Disadvantages? These may not deliver all the investment needed on customer premises. Customers will have limited control over wider investment decisions and timescales as decisions will primarily be made by companies and their regulator. Costs from monopoly providers may be higher than necessary. Cost socialisation may be regressive.

4. Customer-led solutions

What is it? A delivery model where all solutions are designed and funded by the individual customer, including infrastructure investment.

Advantages? Customers and energy users own their own infrastructure and energy management. They control investment decisions and solution designs

Disadvantages? Customers each have to fund potentially large investment costs. Performance risk remains with customer. May lead to inefficient overall investment if costs are not shared.

5. Energy supply company (ESCO)

What is it? A delivery model for private companies to contract with businesses and customers and provide solutions for energy supply and demand infrastructure, and energy management. The aim is to reduce energy costs by managing across the energy value chain of production, distribution and supply.

Advantages? Customers benefit from lower overall energy costs. Allows benefits to be realised from optimisation across supply and demand, including from flexibility markets.

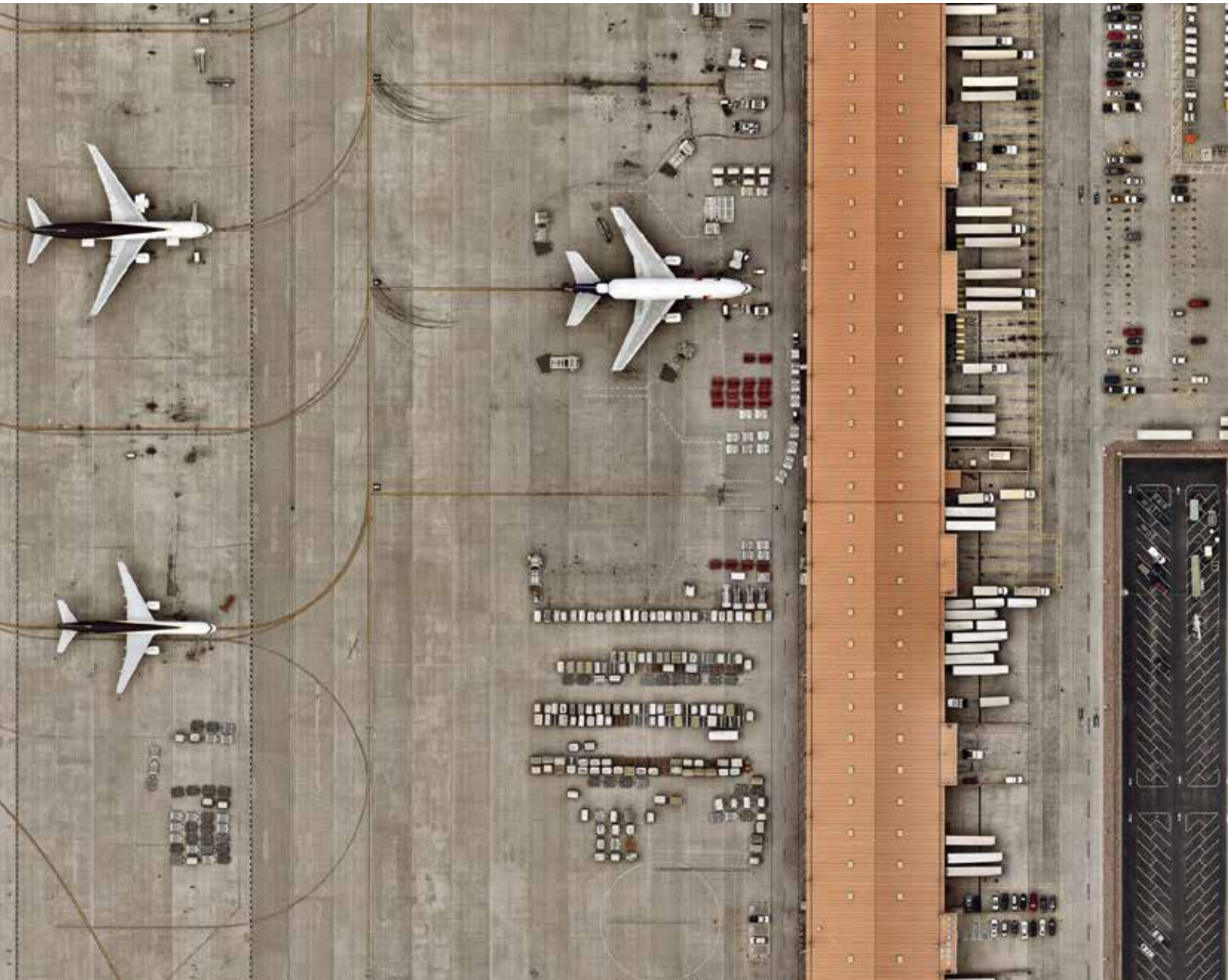
Disadvantages? May not be able to secure sufficient long-term contracts to deliver the necessary infrastructure investment. Contract based structure may be inflexible for future change.

6. Energy as a Service (EaaS)

What is it? A delivery model for diverse solutions that combines infrastructure, software and services. Individual businesses and customers would contract with an EaaS provider for a shared energy service.

Advantages? Customers benefit from predictable subscription payments rather than 'lumpy' capital investments. Allows infrastructure to be developed to serve many customers, thereby sharing costs and enabling efficiencies. Allows benefits to be realised from trading in flexibility markets. Performance risk lies with the EaaS provider.

Disadvantages? An unproven delivery model in the energy sector. Will rely on sufficient customer demand to support the business case and the associated investment.



6. Conclusions and recommendations

Conclusions

The transport sector, covering surface transport, aviation and shipping, currently accounts for about one third of the UK's overall greenhouse gas emissions.

The Climate Change Committee's (CCC) 6th Carbon Budget and the Governments Net Zero strategy target that surface transport and shipping will need to effectively eliminate emissions to achieve the 2050 Net Zero decarbonisation targe. Aviation will be difficult to decarbonise, but a significant proportion of sustainable jet fuel is expected by 2050. A key feature of the Government's decarbonisation strategy across all transport sectors is that energy demand is expected to fall due to transport efficiency improvements but especially due to much lower surface transport volumes.

This report has considered what transport-related progress towards Net Zero would look like within a major UK transport hub, using Southampton and the Solent as an example with its major sea, air, road, and rail links.

We have adapted forecasts from the CCC's Balanced Pathway 2050 scenario to the transport profile in the Southampton Local Authority Area. By 2050, they show:

- A 75% reduction in surface transport energy consumption. Petrol/diesel cars are replaced by electric vehicles, by active transport and mass transit systems.
- A 40% increase in shipping volumes across both freight and passenger traffic, leading to a 20% increase in energy consumption after efficiencies are included. But fossil fuels are replaced by ammonia for propulsion and electricity for shore power.
- A 20% increase in aviation volumes, which largely continue to use jet fuel. But fuel consumption is expected to fall by 20% as efficiencies are realised.

If these transport decarbonisation metrics can be met, then Southampton will be on target to meet its share of the national Net Zero targets. But if these targets cannot be met, then there will be economic impacts as well as environmental ones.

The economy of this region is especially dependent on maritime businesses so the energy transition in this sector will be particularly significant. The maritime sector currently contributes about 20% to the Solent region economy. If the maritime sector grows by the 40% forecast increase in shipping volumes, then this implies a 40% increase in the economic contribution of the maritime sector to the Solent region. The current £6 billion GVA per annum could increase to over £8 billion, an increase of around £2 billion per annum. If a decarbonisation pathway is not pursued, then the region faces the risk of losing this economic benefit to other UK or international ports.

Southampton City Council and the Solent Local Enterprise Partnership have already produced energy plans identifying a range of initiatives to decarbonise in a way which benefits local communities and businesses. But responsibility for delivery and governance of delivery is unclear. Arguably, these plans could be built on and clarified, in order to provide apathway for delivering a Net Zero future for the region.

Recommendations

It is critical that transport decarbonisation strategies and targets set by local and national government work together to optimise the cost of meeting Net Zero targets across the whole energy system. They must connect effectively with the local businesses and communities that will be seeking to implement and benefit from the energy system transition while minimising the transition costs.

The creation and delivery of such a wide-ranging integrated roadmap will be challenging. Clear leadership and governance is needed for planning and delivery, using the most appropriate public or private delivery models. We propose the following recommendations:

1. Integrated transport decarbonisation plans

Local co-ordinated plans will be essential. Each local authority or authority group needs to plan for whole system decarbonisation to achieve Net Zero in their respective regions. We propose that a key local component should be an integrated transport decarbonisation plan.

This integrated transport decarbonisation plan, including delivery of this transition and the associated investment, will need a local strategy and roadmap that is consistent with national policies and targets. We suggest it includes and prioritises:

- An integrated Southampton, and possibly Solent Net Zero transport energy roadmap, with public engagement to encourage the public to change their transport use,
- Ports – accelerated deployment of Net Zero port infrastructure, enabling early deployment of shore power and zero-carbon fuels, and
- Surface transport – a major reduction in road transport volumes through increased public transport, and active transport; accelerated decarbonisation through enabling electric vehicle use and charging infrastructure.

A local integrated transport solution should enable local economic growth from this major transport hub, able to exploit the benefits from pioneering transport decarbonisation technologies. Carbon-free, accessible travel services will also benefit people and communities, improving air quality and enhancing the urban environment.

2. Establishing clear governance and accountability

Local co-ordinated leadership will be essential. It will be important for the governance of local energy plans and transport decarbonisation plans to be clearly defined. Clear delivery plans should help identify the local economic growth opportunities. We suggest clear responsibilities be defined for coordination and management, including:

- Whole energy system design and planning, including decarbonisation targets
- Identifying investment needs and securing finance and associated incentives
- Developing delivery models to contract for infrastructure and service delivery
- Monitoring energy use and ensuring delivery against targets

Options to enable the above should be carefully thought out and could include, for example, the appointment of a specialist energy system design or delivery authority.

3. Enabling transport technology and infrastructure investment

Delivering the energy transition will need investment across the transport supply chain, including new low-carbon transport technologies, production and storage of new zero carbon energy, and distribution infrastructure. Investment needs over the next decade include:

- Electricity infrastructure - investment will be needed for vehicle charging points and electricity networks, and for port shore-side, airport, and rail electrification.
- Zero-carbon fuel infrastructure – new facilities will be needed for hydrogen and ammonia production, transportation, and storage/ bunkering.
- Zero-carbon vehicles – requirements for new ships, trains, aircraft, cars, buses, and other forms of transport

Early, no-regrets investment consistent with Net Zero transport decarbonisation plans should be realised through a range of alternative public and private sector investment models.

Such investments present significant local business opportunities that will support economic growth in the region.

Annex 1 – Energy Demand methodology and assumptions

2019 Southampton Data Assumptions

Energy demand data has been derived for 2019 across the major demand sectors. 2019 was used as a baseline to reduce distortions resulting from temporary demand reductions due to the COVID-19 pandemic. The 2019 data assumptions for Southampton are shown in the following table and described in more detail below:

Table: Southampton 2019 energy consumption (GWh)

2019	Electricity	Gas	Petroleum	Bioenergy	Hydrogen	Total
Industrial & Commercial	506	537	108	0	0	1151
Residential	380	905	29	137	0	1450
Surface transport	0	0	823	37	0	860
Shipping	0	0	881	0	0	881
Aviation	0	0	956	0	0	956
Transport sub total	0	0	2660	37	0	2697
Total	886	1442	2797	175	0	5299

Industrial & Commercial, Residential and Surface Transport

2019 final energy consumption data for Industrial & Commercial, Residential, and Surface Transport (Road/Rail) for the Southampton Local Authority area was sourced from the BEIS 2019 local authority energy consumption statistics[14]. This data set provided a breakdown of consumption by primary fuels, including petroleum, electricity, gas, and bioenergy. Note: this dataset does not include aviation or shipping data.

The methodology used can be found at the following 2030[15]. Electricity and gas data are based on real consumption recorded from meters which is then aggregated to local authority and regional level. Road transport fuel and residual fuel data are modelled using fuel consumption and modelling on a national level and then disaggregated using spatial data.

Aviation

2019 UK energy consumption data for aviation was derived from DfT energy statistics (Table ENV0102 - TSGB0302)[16] where the 2019 total UK petroleum consumption for aviation which was 13.7Mtoe or 159TWh.

DfT air passenger statistics showed that Southampton airport accounted for 0.6% of total UK air passengers in 2019[17]. This percentage was used to calculate Southampton airport petroleum demand. This equates to 956GWh.

Shipping

2019 UK energy consumption data for aviation was derived from DfT energy statistics (Table ENV0102 - TSGB0302)[18] where the 2019 total UK petroleum consumption for aviation which was 947ktoe or 11TWh.

DfT ship freight statistics show that the Southampton port accounted for 7% of UK freight traffic in 2019 and around 10% of all domestic and international passenger traffic[19]. For this analysis, it has been estimated that 8% of all UK shipping energy use is attributable to Southampton port. This equates to 881GWh.

2050 Southampton Data Assumptions

Energy demand forecasts for 2050 have been mainly based on the assumptions made in the Climate Change Committee's Balanced pathway model used to meet Net Zero targets by 2050. The demand changes have then been applied to the 2019 baseline data for Southampton Local Authority Area.

The changes for the Southampton Local Authority Area for both energy demand and fuel type are shown in the following table and described in more detail below.

Table: Southampton 2050 energy consumption scenario (GWh)

2050	Electricity	Gas	Petroleum	Bioenergy	Hydrogen	Total
Industrial & Commercial	562	57	8	59	163	849
Residential	573	0	0	14	39	625
Surface transport	213	0	5	0	20	238
Shipping	42	0	46	0	966	1057
Aviation	11	0	565	131	61	768
Transport sub total	267	0	616	131	1047	2063
Total	1402	57	623	204	1249	3538

Industrial & Commercial

- An overall demand reduction of 26% is assumed from 2019 levels based on the CCC Balanced Pathway assumptions.
- Based on CCC Balanced pathway assumptions, the fuel type assumptions are: electricity - 66%, gas - 7%, hydrogen – 19%, bioenergy - 7% and petroleum - 1%.

Residential

- An overall demand reduction of 57% is assumed from 2019 levels based on the CCC Balanced Pathway assumptions.
- Based on CCC Balanced pathway assumptions, the fuel type assumptions are: electricity - 92%, hydrogen - 6%, and bioenergy - 17%.

Surface transport

- An overall demand reduction of 74% is assumed from 2019 levels based on the CCC Balanced Pathway assumptions.
- Based on CCC Balanced pathway assumptions, the fuel type assumptions are: electricity - 90%, hydrogen - 8%, and petroleum - 2%.

Aviation

- An overall demand reduction of 20% is assumed from 2019 levels. This assumes an UK air traffic increase of around 20% from 2019 levels (as envisaged by CCC/DfT analysis). It is assumed the commensurate increases in energy demand are offset by efficiency savings of c1-2% per annum.
- Based on CCC Balanced pathway assumptions, the fuel type assumptions are: electricity - 1%, hydrogen - 8%, bioenergy - 17% and petroleum - 74%.

Shipping

- An overall demand increase of 20% is assumed from 2019 levels. This is based on UMAS/DfT modelling that shows a potential 40% increase in volumes/traffic for 2050. It is assumed the commensurate increases in energy demand are offset by annual efficiency savings of c1% per annum.
- Based on CCC Balanced pathway assumptions, the fuel type assumptions are: electricity - 4%, hydrogen (ammonia) - 91%, and petroleum - 4%.

With thanks to report author Robert Hull, Director, Riverswan Energy Advisory.
roberthull@riverswan.co.uk

And to the Hitachi Energy team for their support.

www.hitachienergy.com

Find Out More and Support the Sector
For further information, please contact:
Jacob Roberts
Transport Policy Manager, REA
jroberts@r-e-a.net

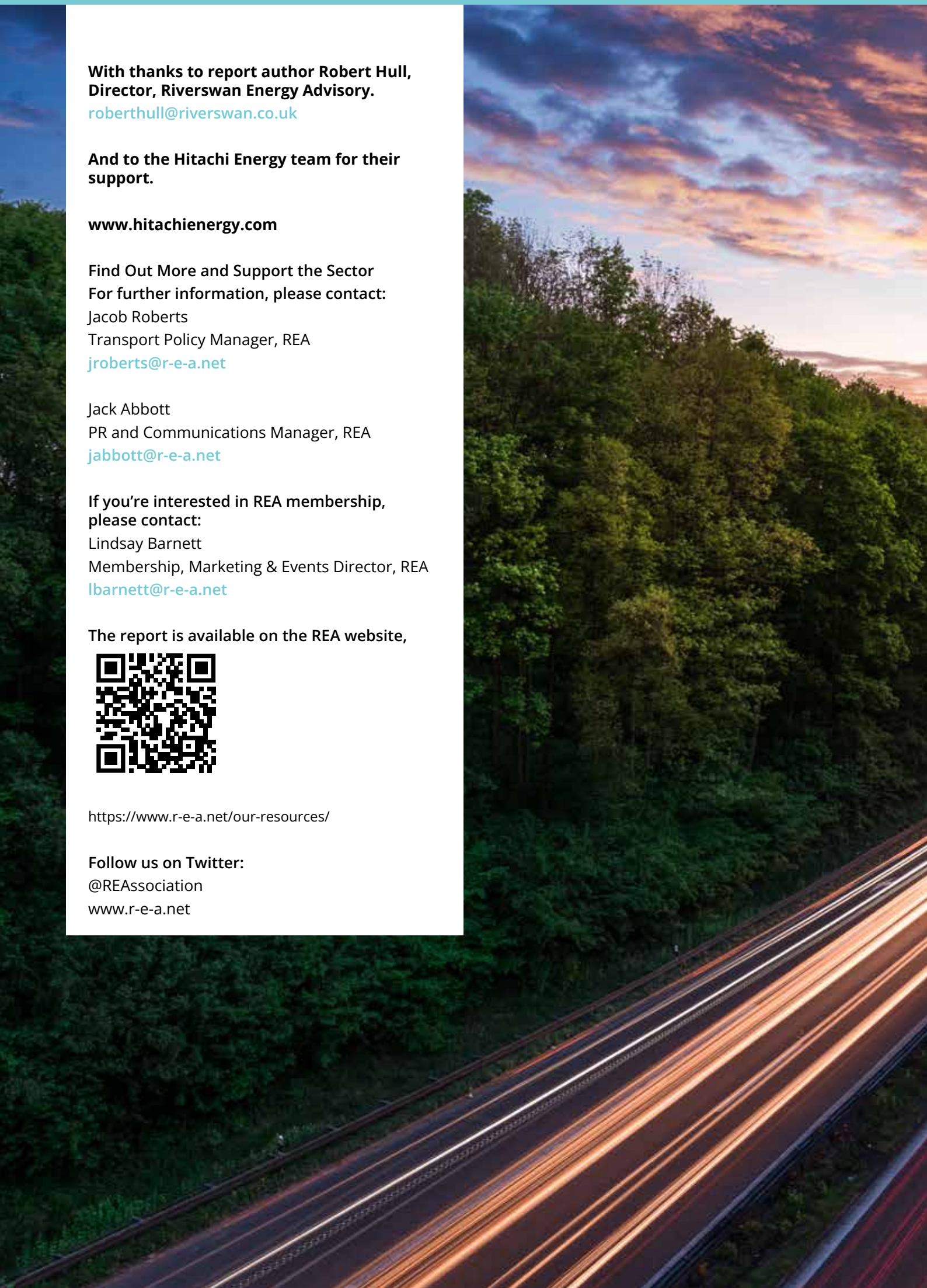
Jack Abbott
PR and Communications Manager, REA
jabbott@r-e-a.net

If you're interested in REA membership, please contact:
Lindsay Barnett
Membership, Marketing & Events Director, REA
lbarnett@r-e-a.net

The report is available on the REA website,

https://www.r-e-a.net/our-resources/

Follow us on Twitter:
@REAssociation
www.r-e-a.net



Footnotes

[1] https://www.theccc.org.uk/publication/sixth-carbon-budget/

[2] This includes emissions from international aviation and shipping. The CCC estimates that emissions from international aviation and shipping totalled 45MtCO2e in 2019.

[3] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1033990/net-zero-strategy-beis.pdf

[4] https://www.theccc.org.uk/2021/10/26/governments-net-zero-strategy-is-a-major-step-forward-ccc-says/

[5] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1009448/decarbonising-transport-a-better-greener-britain.pdf

[6] https://www.gov.uk/government/publications/maritime-2050-navigating-the-future

[7] https://www.southampton.gov.uk/environmental-issues/pollution/green-city/

[8] https://transport.southampton.gov.uk/media/1073/mrd-1-connected-southampton-transport-strategy-2040.pdf

[9] https://solentlep.org.uk/media/2669/solent-lep-heat-and-power-strategy-and-action-plan-final-docx.pdf

[10] https://solentlep.org.uk/media/2319/cebr_solent_lep_report_may-2018.pdf

[11] https://solentlep.org.uk/media/3905/maritime-uk-solent-recovery-plan.pdf

[12] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/970229/Industrial_Decarbonisation_Strategy_March_2021.pdf

[13] https://www.regen.co.uk/publications/scottish-and-southern-electricity-networks-dfes-2020-reports/ The scenario shown is Steady Progression which does not reach Net Zero by 2050.

[14] https://www.gov.uk/government/statistics/total-final-energy-consumption-at-regional-and-local-authority-level-2005-to-2019

[15] https://www.gov.uk/government/publications/regional-energy-data-guidance-note

[16] https://www.gov.uk/government/statistical-data-sets/energy-and-environment-data-tables-env

[17] https://www.gov.uk/government/statistical-data-sets/tsgb03 (Table ENV0102)

[18] https://www.gov.uk/government/statistical-data-sets/energy-and-environment-data-tables-env

[19] https://www.gov.uk/government/statistical-data-sets/sea-passenger-statistics-spas

THE ASSOCIATION FOR RENEWABLE ENERGY AND CLEAN TECHNOLOGY

Brettenham House, 2-19 Lancaster Place,
London, WC2E 7EN

Tel: +44 (0)20 7925 3570

Email: info@r-e-a.net Web: www.r-e-a.net

Company no: 04241430

Registered in England and Wales