**Climate mitigation and adaptation action in the UK and devolved nations – A typology**

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**Approach**: JB extracted actions described in the UK National Adaptation Programme 2018, the UK Climate Change Risk Assessment: Government Report 2012 and the Net Zero Strategy: Build back greener 2021 documents (365 actions extracted in total). She then grouped these actions to develop the typology and cross-checked the typology with devolved government policy documents including the Scottish Climate Change Adaptation Programme 2019, the Prosperity for All: A Climate Conscious Wales – a climate adaptation plan for Wales 2019, the Northern Ireland Adaptation Programme 2019-2024 and the Northern Ireland The Path to Net Zero Action Plan 2022. The plan is to use this typology to create a search strategy for a systematic literature review on the impact of these different actions on health and health inequalities.

\*Note the typology is not an exhaustive list of every policy and action implemented or endorsed but instead captures the types of policy and action, and provides examples.

**Overview:**

1. Biodiversity
2. Biosecurity and Communicable Disease
3. Forestry
4. Water availability & quality
5. Agriculture and Land Use
6. Blue & Green Infrastructure
7. River and coastal floods & erosion
8. Buildings & Infrastructure
9. Cleaner Energy and reducing emissions
10. Phasing out and regulating fossil fuels Is this specific to fossil fuels themselves…or does this more widely encompass carbon, carbon emissions regulations, and carbon markets?
11. Invest in Renewables
12. Nuclear and Hydrogen Power
13. Technological Innovation
14. Dietary Change
15. Greener Transport
16. Temperature Changes
17. Marine Conservation
18. Natural Carbon Sinks/Land Conservation
19. Business & Industry
20. Waste
21. **Biodiversity**

Actions with the purpose of enhancing the biodiversity of both animal and plant species. Biodiversity issues are around biodiversity loss, and a recognition that due to climate change enhancing biodiversity might be about enhancing species that don’t currently live in a particular place, but may in the future. Given the changing climate certain adaptation in the form of crop species diversification is recommended to maintain food supply chains in the UK. Nationally and globally there is a huge focus on crop species diversification. Linked between biodiversity and forestry are tree planting initiatives that move away from monocultures and towards diverse broadleaf trees to help ensure biodiversity. Wildflower meadows are encouraged in place of lawns and there has been a push to create connecting habitat corridors to support biodiversity. Other examples of adaptive action in this category are species recovery programmes, species reintroduction and translocation projects, and monitoring species vulnerability to climate change to identify species at particular risk.

1. **Biosecurity and Communicable Disease**

Actions which aim to surveil and tackle the emergence of non-native animal species, plant and animal disease threats, exotic vector borne diseases because of the changing climate. Surveillance measures include a robust system of horizon scanning and international monitoring for new and emerging diseases, plant health risk assessments and UK Plant Health Risk Register, and non-native species surveillance and risk analysis (e.g., the National Bee Unit use the dedicated alert system which allows the public to report Asian hornet sightings). Other actions include eradication of high priority non-native species, contingency plans to deal with invasive mosquitoes to cover other veterinary and medically important insect vectors and awareness campaigns including the Check, Clean, Dry and Be Plant Wise campaigns, and particular efforts to deal with intrusive plant species such as Japanese knotweed.

To tackle vector borne pathogens Scotland are implementing a vaccination transformation programme to move away from a model based on GP delivery to one based on NHS Board delivery. Underserved populations experience inequalities in health and are often undervaccinated – during the vaccination transformation programme transition it is important that vaccination coverage is maintained or improved and inequalities reduced.

Food Borne diseases are also of concern in Scotland and several measures have been put in place to reduce the risk; Promoting Food Safety commercially via Food Standards Scotland, Promoting Food Safety in the home by raising awareness of the importance of undertaking good food hygiene practices in the home through targeted media campaigns, and the strategy for reducing foodborne illness.

1. **Forestry**

Actions which impact the forestry industry either by changing current practices or encouraging the creation of new woodland. This includes a move to alternative forest management systems and mixed and native woodland in line with the UK Forestry Standard recommendation on species diversification, the introduction of the Glastir(?) woodland management grant scheme: funds the development of guidance on woodland management and agricultural systems and investigates the benefits of urban tree planting for shade and drainage. Critically there is a lot of action that supports and endorses the creation of new woodland and the conservation of existing woodland including the rural development plan, the UK Forestry Standard guidelines on forests and climate change, and incentives for creating new forest and additional tree planting on private land (e.g., Forestry Investment Zones). A major project is the planting of a new Northern Forest in England which will cross the country using the M62 corridor as its spine, which not only delivers additional greenspaces but also contributes to meeting carbon budget commitments and the annual planting rate of 5,000-10,000 ha of new woodland habitat, to achieve 12% woodland cover by 2060. The government will also continue to facilitate open habitat restoration by granting unconditional felling licenses for the removal of woodland planted on former wildlife-rich habitat of exceptional biodiversity interest such as heathland, ensuring appropriate levels of replanting to support the ambition to increase woodland cover. There are also plans to develop a policy roadmap to increase the use of timber in construction in England by creating cross-government and industry working group tasked with identifying key actions to safely increase timber use and reduce embodied carbon.

Another aim is to embed adaptation into forestry research programmes to improve the knowledge of likely climate impacts and contribute to the development and uptake of climate resilient trees and relevant technologies. Another action is to better integrate forestry and farming to enhance farm resilience and productivity as new policies and incentives are developed following BREXIT.

Another strand of forestry related action concerns wildfires in the form of providing wildfire prevention training to Fire and Rescue Services and Land Managers using the UK Forestry Standard’s Practice Guide Building Wildfire Resilience into Forest Management Planning and enhancing wildfire prediction systems to improve preparedness.

1. **Water availability & quality**

Actions which impact water availability and quality, specifically protecting freshwater sites and actions which control water use, leakage, and waste (e.g., Drainage and Wastewater management plans). A major target area for actions in this category are a focus on abstraction including reforming abstraction licenses particularly to prevent 30 billion litres of water per year being removed from the environment where abstraction is unsustainable, capping abstraction and introducing controls to protect water sites at low flows and to avoid damaging the environment. Another strand of action involves restoring protected freshwater sites to favourable condition and removing or reducing other anthropogenic pressures (e.g., overfishing, over-abstractions, damming, pollution, and habitat destruction), and protecting natural processes within river systems (e.g., Catchment and River Basin Management plans) to enhance water storage capacity to buffer against drought and provide a semi-natural habitat with a valuable role to play in increasing resilience of wildlife to a changing climate. Investment more than £75 million has been made by Water Utilities in UK since 2000 on waste and water-treatment and infrastructure to improve shellfish quality.  An adaptation is adjusting the use of surface water and groundwater sources to make the best use of water when it is available while protecting the environment.

Another aim is to reduce per capita water consumption, a common performance commitment for all companies in addition to reducing water supply interruptions, which covers a period of drought. Another priority for companies is to assess the extent to which their major water treatment works, and sewage treatment plants, and water company infrastructure assets are appropriately resilient to extreme flood events including temporary defences, network rezoning plans and small-scale adaptation measures (e.g., raising electrical equipment). Water companies should develop and implement twin-track approaches; initiatives to reduce the demand for water (e.g., educational campaigns, mandatory water labels, water meters) and securing new water supplies via new reservoirs and water transfers. Water intensive businesses may need to consider locations which are less water stressed to mitigate their risk. National level targets are to set a target for per capita consumption with water UK and water companies and to publish the national policy statement for water resources to accelerate the development of large water resource infrastructure by streamlining the planning process.

1. **Agriculture and Land Use**

Actions which change the operation of the agricultural sector, which often intersect with other types of mitigation and adaptation action.  In the 25 Year Environment Plan the UK government have committed to support farmers to turn over fields to meadows rich in herbs and wildflowers, plant more trees, restore habitats for endangered species, recover soil fertility and attract wildlife back. Some actions endorsed or implemented via the agricultural sector intersect with water availability and quality. For example, water management in agriculture to ensure sustainable use of water resources and resilience of supply through abstraction licenses, encourage the use of low-emissions sustainable fertilizer (e.g., bio-stimulants, recycled fertilisers) to improve nutrient use efficiency and reduce the potential for negative impact on water quality and air quality. There is also a lot of action around soil conservation and quality including protection through outcome-based cross-compliance soil rules, the UK Forestry Standard’s Forests and Soils Guidelines and the Countryside Stewardship scheme. Other measures to improve soil quality include the development of guidance on optimal tillage and crop establishment, the Environmental Land Management scheme which pays farmers for certain environmental benefits including soil quality and, a soil health index. The other intersection is with extreme weather events, for example using farmland and methods of farming to mitigate flood risk, actively promoting awareness of flood risks to farm businesses, and effective management of the impact of volatility in the occurrence and severity of rainfall events on water availability, flooding, soil erosion and pollution due to run off.

The government has also invested in programmes to encourage knowledge transfer, advice and skills development on climate change impacts and possibilities (e.g, the Farming Connect Programme), and funding to support the uptake of new technologies and equipment by farmers (e.g., the Countryside Productivity scheme). Agri-environment schemes have been put in place to maintain a high proportion of agricultural land, and crop species diversification encouraged. The government is also stimulating industry-academia collaboration (e.g., Agri-tech catalyst) which will help improve productivity and contribute to more environmentally sustainable agricultural systems, and with industry encouraging widespread adoption of precision agriculture, pioneer new approaches to crop protection and encourage more commercial research to improve plant breeding, agronomic techniques, and new approaches (e.g., vertical farming) which can help deliver net zero in agriculture and horticulture. The target being that by 2030, 75% of farmers will be engaged in low carbon practices, risking to 85% by 2035. Another concern is food security which is inter-linked with land use, habitats and land management.

The Planning (Scotland) Bill was passed by the Scottish Parliament and puts communities and interested people and organisations at the heart of land-use planning.

1. **Green and Blue Infrastructure**

Action which supports the development of green infrastructure; the living network of greenspaces, water, and other environmental features in both urban and rural areas, which can help reduce extreme temperatures and manage water flows that affect buildings. This includes the launch of the green infrastructure partnership which provides the opportunity to demonstrate the benefits that well designed high quality green infrastructure can provide, the promotion of urban tree planting via Community Forests, and the development of a green infrastructure standards that can be easily accessed by local GI planners, designers, and managers to help them deliver good quality local GI, particularly in disadvantaged urban populations. One target by the government is to plant one million urban trees and create more better quality and well-maintained green infrastructure. Nature-based solutions (actions to protect, sustainably manage and restore natural or modified ecosystems) are also becoming increasing important.

1. **River and Coastal Flood & Erosion**

Actions that tackle flood (from any source) and coastal erosion mainly via infrastructure, flood warning systems and increased awareness of the risks and how to protect businesses and individuals from risk. In Scotland RiverTrack community flood warning is a low cost sensor system that provides real time water levels to local communities where traditional flood warning schemes are not available. The Environment Agency and other risk management authorities are expected to provide improved flooding and coastal erosion protection to at least 145,000 households in the next four years, and invest in property flood resilience following the property flood resilience action plan. Avoid inappropriate development in areas at risk of flooding or coastal change by directing development away from areas at highest risk. At the local authority level each area must have an up-to-date local plan to set out a vision and a framework for the future development of the area, which should be steered away from areas of flood risk and assess the cumulative impacts of flood risk, rather than to or from individual development sites. In terms of building development sustainable drainage systems (SuDS) are recommended, especially in new developments. Designing properties, infrastructure, and communities to withstand flooding when it happens and speed recovery where it does with simple measures such as flood gates, air brick covers, fitting a pump, having solid floors, or raising electrics in buildings. There is also a SEPA Flooding Strategy in place, SEPA flood maps and SEPA planning advice.

Airports within proximity to rivers and stream networks have the responsibility to develop their own flood resilience strategies (e.g., contingency measures to divert services). Likewise, ports have established procedures for handling and monitoring current and future flood risk (e.g., rehearsed flood plans), fitting larger lock gates and increasing the height of flood defences). Network rail continue to monitor adverse weather through visual and thermal imaging and have funded to build resilience into the rail system examples of action: building pumping stations in flood-prone locations and installing infrastructure at higher levels when renewing infrastructure in flood prone areas. Highways England is also taking action to safeguard against flooding on the road network by reducing flood risk to communities adjacent to the network and focusing on addressing high priority food risk locations recorded in the Drainage Data Management System using major road schemes and flooding hotspot improvements. The department for transport has set up ‘tidal surge’ workgroups across the UK to understand and assess the local risk of coastal flooding and develop mitigating measures. DfT are also identifying bridges that could potentially become a single point of failure for other infrastructure operators and could be at risk in a severe flood event (monitoring levels using specialist monitoring cameras) to ensure appropriate mitigation measures are adopted where feasible. Use innovative techniques (BridgeCat) that allows safe and rapid assessment of the prevalence of bridge scour inherent in the national bridge stock.

In terms of individual adaptation behaviours, individuals are encouraged to keep greenspace green and surface water drains free from debris to increase local drainage and prepare for flood events. There are multiple measures that can prevent flood warer from entering a home, and minimize the damage if it does – homeowners are encouraged, where they can, to invest in measures to reduce the impact of a flood event. Property owners can learn more about their historic properties – as some traditional buildings may become less able to cope with changing weather patterns, Historic Environment Scotland have developed a guide that describes the key external aspects of a traditional building that provide protection against the elements.

Companies also have a role to play, for example electricity companies have spent millions on flood defence work in recent years. The Department for Business Energy and Industrial Strategy (BEIS) continues to monitor the network companies on their build programmes to make sure progress across the sector remains on track. Where defences are not yet built (flood/landslide), all sites have been surveyed for suitability for temporary defences. Electricity network companies have continued to manage surface water flooding. Funding for this work is obtained by the Downstream Gas and Electricity sectors through the RIIO (Revenue = Incentives + Innovation + Outputs) price control. This is a ceiling on the amount companies can earn from charges to use the networks. Industry provides regular updates to BEIS, detailing their progress on addressing risks from surface water flooding. Update and implementation of guidance for electricity sub stations against flood risks. Revised design guidelines (ETR138) state that primary substations with over 10,000 connections should be defended against 1/1000-year flood events. Ofcom’s revised security guidance (published December 2017) contains explicit requirements for telecoms providers to ensure they meet NFRR obligations and to ensure all sites (not just those in scope of the NFRR) are adequately protected from flooding. For nuclear installations including operating reactors, the Office of Nuclear Regulation’s (ONR) Safety Assessment Principles underpin the regulatory oversight and scrutiny of licensees’ safety submissions throughout the lifecycle of the installation. The submissions must reflect internal and external hazards including the reasonably foreseeable effects of climate change over the lifetime of the facility as well as other factors such as coastal erosion, extreme weather, and flooding. This approach is also reflected in joint guidance ONR has produced with the national Environment Agencies for nuclear new buildTelecommunications sector to implement remaining programme of installation of permanent flood defences. The National Infrastructure Resilience Council (NIRC) brings together utility companies to share information about the locations of their assets and to take a coordinated approach to flood resilience.

In terms of natural infrastructure natural flood management approaches can provide opportunities to manage water flow, potentially reducing the risk of flooding and the established network of habitat compensation programmes continues to identify coastal habitat creation opportunities. The Government’s £2.6 billion six-year capital investment programme to reduce flood and coastal erosion risk will provide over £30 billion in economic benefits. The capital projects supported by this funding already include a combination of engineered interventions, resilience measures and working with natural processes/natural flood management; and the government have earmarked £15m to specifically encourage natural flood management projects, which will further expand the evidence on how these can reduce the impact of flood events and complement more structural hard defences for flood mitigation. Flood plains managed well can provide temporary flood storage areas. The government plan to update the national flood and coastal erosion risk management strategy with the aim of strengthening join delivery across organisations.

There is policy in place to protect assets from flood risk and coastal erosion, and the government are ensuring everyone can access the information they need to assess any risk to their prosperity or health from flooding and coastal erosion and supports individuals to make their properties more resilient. The establishment of Flood Re has also provided affordable insurance to households at high flood risk who would otherwise have struggled to obtain affordable cover. Other practical measures include investing in defences (e.g., flood walls, sea defences and embankments) and in soft engineering which works with natural and erosion processes to manage the volume, timing, and speed of water flow. Appropriate arrangements for forecasting and response to flooding incidents (e.g., warning systems).

1. **Buildings and Infrastructure**

Actions which prepare buildings and infrastructure to be resilient to extreme weather events and adapt to the changing climate. The government seek to ensure that infrastructure is located, planned, designed, and maintained to be resilient and reduce the risk of cascade failures by improving understanding and systems management of interconnected and interdependent services, building on the energy sectors good understanding of relevant interdependent networks. An Infrastructure Operators’ Adaptation Forum (IOAF) working group has made progress on developing a tool to help identify and assess infrastructure dependencies and interdependencies. There is now IOAF agreement that a matrix-based approach could provide a practical means of identifying and mapping interdependencies, and of capturing supporting evidence towards identifying solutions (e.g., adaptation measures).

In terms of transport systems, the ‘new aviation strategy’ will consider the challenges for the wider resilience of the airport system that needs to be addressed by the aviation sectors continued growth. In parallel, the government must ensure that growth is sustainable and is balanced with local and global environmental concerns. Network rail also look to reduce the risk from landsldes by introducing a programme aimed at identifying sites, trialling remote condition monitoring to detect potential earthwork failures and using this data take targeted remedial action (e.g., improved drainage to stabilize the slope) before failures occur. Network rail continue to comprehensively manage its assets against geotechnical faults, identifying sites vulnerable to landslips using light detection and ranging surveys, in place motion sensors, CCTVV and ground investigations. Network Rail is also funding research into novel slope stabilisation techniques and the scope for using new technologies to tackle slip-slope type failures; and to reduce disruption caused by high winds. Network Rail also have comprehensive procedures in place to manage vegetation in lineside locations, where vegetation can impact passenger services. Any vegetation removal is conducted in accordance with Network Rail’s environmental policy, which aligns with industry best practice. This requires Network Rail to consider surrounding wildlife and where possible, mitigate the impact of de-vegetation work to minimise the impact it may have on the environment. Network Rail have also established wind monitoring stations at key locations on the network. This enables Network Rail to monitor and prepare in advance of potentially dangerous weather conditions, allowing guidance to be disseminated to drivers so that they may limit their speeds, if necessary. DfT encourages train operators to improve the resilience of their rolling stock, through the guidance the rail industry publishes on the specification and manufacture of new trains. The document, Key Train Requirements, which is used to inform franchise specifications and train design, contains advice on how to ensure trains’ performance can be maintained throughout the vehicles’ lives in a wide range of climate conditions.

In terms of our highways the effects of extreme weather events on highway infrastructure assets should be risk assessed and ways to mitigate the impacts of the highest risks identified. Slope stability is well understood and regular inspections to evaluate stability are in place. Several tools are in place to deal with hazard assessment on slopes. For example, the Design Manual for Roads and Bridges (HD22/08) sets out the standards for assessing and analysing the stability of earthworks such as cuttings and embankments, including any conditions that may contribute to future stability, such as drainage and groundwater conditions. Current arrangements for managing risks of falling trees through winds and storms are set out in HE’s Asset Maintenance and Operation Requirements (AMOR) which has a specific section covering tree safety and states to “minimise the risk of trees or vegetation falling on the Area Network that could represent safety risk, obstruction, or nuisance. This includes, but is not limited to, trafficked or pedestrian areas”. Overall, government is providing over £6 billion to highway authorities from 2015 to 2021 for highways maintenance. DfT introduced an incentive element into the funding allocated to local authorities for local highways maintenance. This enabled local authorities to identify and use a local resilience network on transport infrastructure.

To protect Health & Social Care infrastructure several actions been put in place in Scotland including the development of a climate hazards and vulnerabilities risk screening tool for healthcare assets, NHS Board climate change risk assessments and adaptation plans, NHS Scotland sustainability strategy and assessment tool, a National Code of practice for GP premises and a GP premises survey. These measures evaluate the risk of damage to healthcare assets and sites, identify mitigating action, and evaluate and assess the sustainability of the current healthcare structure. In terms of services it is known that extreme weather events such as floods, storms, cold and hot weather and heatwaves impact the NHS and social care providers. There are several measures in place in Scotland to ensure they can continue to deliver services as the climate changes including the NHS Standards for Organisational Resilience, the Clinician Strategy for Scotland, and Realistic Medicine.

1. **Cleaner Energy**

Actions which reduce carbon emissions to support a move to zero emissions. This includes phasing out or regulating the use of fossil fuels, and investing in cleaner lower carbon alternatives including renewables, nuclear and hydrogen power. Other measures include a focus on energy efficiency and heating systems in buildings and innovation to support a transition to low carbon alternatives.

Government and regulators will continue to work with industry to drive emissions reductions, including through improved process efficiency, to stay on track for CB6. The government are updating the energy National Policy Statements to provide greater clarity on the need and urgency for low carbon infrastructure, exploring ways of streamlining processes through the Nationally Significant Infrastructure Projects (NSIP) reform programme and addressing issues at a strategic level, for example through the Offshore Wind Enabling Actions Programme.

***Phasing out and regulating fossil fuels***

One major endeavour is to phase out and regulate the use of fossil fuels: coal, oil, and gas. The government has pledged that the next 30 years will see a decisive and permanent shift away from the use of unabated oil and gas as the engine of our economy. They are also introducing measures that ensure any new build combustion power stations (including gas) can convert to clean alternatives in the future. In some devolved countries they will no longer build new unabated gas plants by 2030. The government are consulting on phasing out the dirtiest and most expensive fossil fuels first - new oil, coal, and liquefied petroleum gas heating - and replace with low carbon alternatives in non-domestic buildings from 2024 and homes from 2026, following natural appliance replacement cycles. There is also a requirement that all publicly funded buildings are to be carbon neutral. The tackling fuel poverty plan is also in place to support people struggling to meet the cost of their domestic energy needs.

In terms of regulations, the revised Oil and Gas Authority (OGA) strategy empowers the authority to assess operators plans to reduce their emission levels against effectively a net zero test and establish a climate compatibility checkpoint for future licensing on the UK Continental Shelf. Future projects in the industry also require consent from the OGA. The government will work with stakeholders to address barriers to electrification of oil and gas production by 2022 and continue to drive down routine flaring and venting. Additionally, the gas network must be effective at minimising gas leakage and associated emissions by replacing iron pipes with plastic, even with gas demand decreasing leading to 2050. Through network price controls, Ofgem has set gas distribution companies a target to replace 15,500km of iron mains and associated services in 5 years, from April 2021.

Upstream, the North Sea Transition Deal (NSTD) has set us on a transformational path to deliver the long-term skills, innovation, infrastructure, and investment required to decarbonise oil and gas production and industry more widely. The government have endorsed industry’s commitment in the NSTD to accelerate reductions beyond the World Bank’s ‘Zero Routine Flaring by 2030’ initiative and new OGA guidance sets out the expectation that all facilities should have zero routine flaring and venting by 2030 or sooner. Industry is taking steps through its Methane Action Plan for continuous emissions reductions with specific methane emissions reduction targets, whilst setting the expectation that assets will have individual action plans by 2022. There are also plans to electrify existing and new offshore assets, through connections to onshore networks or offshore renewables. Offshore oil and gas licensing will introduce a formal climate compatibility checkpoint on future licensing round for oil and gas exploration.

***Invest in Renewables***

Another strand of action is to invest in renewable energy from wind, solar, and bioenergy. The government have attempted to accelerate the deployment of low-cost renewable generation (e.g., wind and solar) through the Contracts for Different scheme by undertaking a review of the frequency of the scheme auctions. They plan to deliver 40GW of offshore wind, including 1GW of innovative floating offshore wind by 2030, and seek to ensure a facilitative environment for the deployment of unsubsidised rooftop solar to complement the market-based approach of ensuring exporters receive a fair price through the Smart Export Guarantee. Bioenergy has already played a significant role in decarbonising the electricity system, accounting for 12.6% of total renewables generation in 2019. Technological changes mean that biomass usage can now go beyond carbon-neutral and deliver negative emissions by combining it with carbon capture and storage (BECCS). The Northern Irish government are also investing in research to inform future decisions on suitable locations for accessing geothermal heat and to better understand the potential role that geothermal energy can play in Northern Irelands energy mix.

***In buildings***

The government aim to phase out the installation of new and replacement natural gas and oil boilers in 2035, and once costs of low carbon alternatives have come down, including any hydrogen ready boilers in areas not converting to hydrogen, to ensure that all heating systems used in 2050 are compatible with net zero.  They will introduce regulations from 2025 to ensure all new homes are ready for net zero by having a high standard of energy efficiency and low carbon heating installed (e.g., heat pump, low carbon heat networks). To support this transition one plan is to make heat pumps as cheap to buy and run and grow the health pump market. There is also a new £450 million Boiler Upgrade scheme providing £5,000 capital grants and a new market-based incentives for heating system manufacturers and investment in heat pump innovation to make them smaller and easier to install. Under the £338 million Heat Network Transformation Programme, the government will launch the £270 million Green Heat Network Fund to grow the market for low carbon heat networks. They will also pass new legislation to regulate the sector for consumers, give heat networks the statutory powers they need to build, and regulate the carbon emissions of projects from the early 2030s. The government will also deliver new heat networks zones in England by 2025 where heat networks are the default solution for decarbonising heating. The government have committed to action on addressing distortions in the fuel prices to ensure that low carbon technologies are no more expensive to run than fossil fuel boilers.

The government will provide £800 million additional funding to the Social Housing Decarbonisation Fund (SHDF) over 2022/23 to 2024/25, which will deliver energy performance improvements to social housing. They will also consider setting a long-term regulatory standard to improve social housing to EPC Band C and consider levers required to decarbonise the stock in line with net zero. They also aim to ensure as many fuel-poor homes as reasonably practicable achieve a minimum energy efficiency rating of C by the end of 2030. To help achieve this, the government will provide £950 million additional funding over 2022/23 to 2024/25 for off-gas-grid properties through the Home Upgrade Grant (HUG) to provide ongoing support for low-income households living off the mains gas grid with energy efficiency and low carbon heating upgrades.

All our electricity will come from low carbon sources, subject to security of supply, bringing forward the government’s commitment to a fully decarbonised power system. Drive market-wide rollout of smart meters with a new four-year policy framework that introduces fixed minimum annual installation targets for energy suppliers from 1 January 2022. Smart meters enable innovative products and services such as smart time-of-use tariffs. These tariffs reward consumers financially for using energy outside peak times when demand is low or when there is excess generation available.

The government aim to reduce the energy consumption in commercial and industrial buildings in England and Wales by 2030, using measures including regulations and a performance-based measurement scheme. They are also setting a minimum energy efficiency standard of EPC Band B by 2030 for privately rented commercial buildings in England and Wales. The government have published a policy framework setting out illustrative proposals for raising minimum energy performance standards and improving consumer information for a range of high potential products, including but not limited to space heating, cooking, taps and showers and lighting.

***Nuclear and Hydrogen Power***

The government are investing in nuclear power and power CCUS and flexible technologies such as interconnectors, electricity storage, and demand-side response. There is consideration of large-scale and advanced nuclear technologies, including Small Modular Reactors (SMRs) and potentially Advanced Modular Reactors (AMRs). As part of this, the government have announced a £120 million Future Nuclear Enabling Fund to provide targeted support in relation to barriers to entry. Additionally, there is a £385m Advanced Nuclear Fund and are progressing plans for an Advanced Modular Reactor demonstrator in the early 2030s. Whether large- or small-scale projects, there remain several possible sites available for these options, including Wylfa in North Wales.

The government are also establishing large scale trials of hydrogen for heating to take decisions in 2026 on the role of hydrogen in decarbonising heating and consult on the case for enabling or requiring hydrogen-ready boilers and broader heating system efficiencies. They are exploring the system need and case for further market intervention for long duration storage and hydrogen in power. This all feeds into the ambition to achieve 5GW for hydrogen production capacity which could support over 9,000 jobs in 2030, across the full hydrogen value chain. Meeting the delivery pathways set out in the Journey to Net Zero chapter could support 13,000-19,000 jobs across the hydrogen economy by 2035. Blending hydrogen into the gas grid could also support initial steps to decarbonise heating. This will consider the air quality impacts of hydrogen combustion in domestic settings. The government have set up the Industrial Decarbonisation and Hydrogen Revenue Support (IDHRS) scheme to fund new hydrogen and industrial carbon capture business models. The government will be providing up to £140m to establish the scheme, including up to £100m to award contracts of up to 250MW of electrolytic hydrogen production capacity in 2023 with further allocation in 2024.

***Technological Innovation***

The government is actively taking steps to bring forward low carbon technologies capable of replicating the role of unabated gas in the electricity system, including CCUS-enabled generation, hydrogen-fired generation, BECCS, and flexible storage. Flexibility from technologies such as energy storage, smart and bidirectional charging of electric vehicles, flexible heating systems, and interconnection could save up to £10 billion per year by 2050 by reducing the amount of generation and network needed to decarbonise. Maximising system flexibility, including through storage technologies, demand side response, and interconnectors; to integrate renewables, balancing the intermittency of renewables and helping to maintain system operability.

***Dietary Change***

With the NetZero strategy there is an aim to reduce all meat and dairy consumption by 35% by 2050.

1. **Greener Transport**

Actions which aim to make a variety of methods of transportation more environmentally friendly by reducing carbon emissions. This includes ending the sale of new petrol and diesel cars and vans from 2030; from 2035 all new cars and vans must be zero emission at the tailpipe, and by introducing a zero-emission vehicle mandate setting targets for a percentage of manufacturers new car and van sales to be zero emission each year from 2024. To support this effort to shift to electric cars the government will ensure the UKs charging infrastructure network is reliable, accessible and meets the demands of all motorists – including the publication of an electric vehicle infrastructure strategy, setting out a vision for infrastructure rollout and roles for the public and private sector in achieving it. There is also a pledge to end the sale of all new, non-zero emission road vehicles by 2040 which also includes motorcycles, buses, and HGVs.

To facilitate the use of public transport such as buses there is action to increase the average road vehicle occupancy by 2030 and reduce the barriers to data sharing across the transport sector. There are also plans to invest £3 billion in the National Bus Strategy, creating integrated networks, more frequent services, and bus lanes to speed journeys, and support the delivery of 4,000 new zero emission buses and the infrastructure needed to support them. There are also plans to electrify more railway lines to deliver a net zero rail network by 2050, with the ambition to remove all diesel only trains by 2040.

Commercially in the domestic maritime sector the sale of new non-zero emission domestic shipping vessels will be phased out and the development of zero emission technology and infrastructure will be accelerated. The government will engage with industry to explore establishing a UK Shipping Office for Reducing Emissions (UK-SHORE) to transform the UK into a global leader in the design and manufacturing of clean maritime technology (e.g., alternative fuel powered vessels, highly efficient batteries). The UK also aims to become a leader in zero-emission flight, kick-starting commercialization of UK sustainable aviation fuels (SAF) and developing a UK SAF mandate to enable the delivery of 10% SAF by 2030 which will be supported with £180 million of funding.  Aviation emissions will also be addressed through new technology such as electric and hydrogen aircraft, the commercialization of sustainable aviation fuels, increasing operational efficiencies, developing, and implementing market-based measures and GHG removal methods while influencing customers to make more sustainable choices when flying. The government will also support and encourage modal shift of freight from road to more sustainable alternatives, such as rail, cargo bikes and inland waterways.

Finally, the UK government encourage the uptake of active transport by increasing the share of journeys taken by cycling and walking. To facilitate this, they will invest £2 billion in cycling and walking, including building miles of segregated cycle lanes. The other aim is to create at least one zero emission transport city.

More generally the government are working with the sector to help develop a low carbon fuel strategy for transport for publication in 2022, as announced in the recent Transport Decarbonisation Plan, and deliver commitments on sustainable aviation fuels. Additionally, the Renewable Transport Fuel Obligation (RTFO), has supported the market for low carbon fuel supply since 2008. Fuels supported under the RTFO need to comply with sustainability criteria such as minimum GHG thresholds, and by incentivising fuels produced from wastes, it saved 5.37 MtCO2e in 2019 alone. Further to sub-targets for so-called development fuels of strategic importance, the government have recently widened support to more diverse fuels and announced more ambitious targets for the RTFO to 2032 set at 14.6% of total liquid fuel supply. Renewable fuels supplied under the Renewable Transport Fuel Obligation (RFTO) accounted for 5% of total road and non-road mobile machinery fuel. This mainly consisted of biodiesel and bioethanol but also included biomethane and renewable hydrogen, and biogas. To accelerate the development of UK plants to produce advanced fuels the goverment have provided grant funding through schemes including the Future Fuels for Flight and Freight Competition (F4C) and Advanced Biofuels Demonstration Competition (ABDC).

Greener transport impacts the air quality by reducing pollution. There are also specific measures in place in Scotland to tackle air quality including the Cleaner Air for Scotland Strategy that works through the delivery of low emission zones, the Electric Vehicle Charging Network through ChargePlace Scotland whereby Transport Scotland are supporting increased uptake of electric vehicles by providing support for home charge points for consumers, providing workplace charge points, delivering charging points across major routes (e.g., Electric A9), providing funding to towns and cities to meet local EV transition needs such as charging initiative for tenements and EV incentives, providing funding for the expansion of the charging network and supporting the installation of domestic and workplace charge points. In addition, Scotland have committed to reduce car kilometers by 20% by 2030.

1. **Temperature Changes**

Actions primarily to adapt to changing temperatures following climate change. This includes Heatwave plans for UK countries; a framework for preparing and responding to heatwaves. For example, the Heatwave Plan for England aims to reduce summer deaths and illness by raising public awareness and triggering actions in the NHS, public health, social care and other community and voluntary organisations to support people who have health, housing or economic circumstances that increase their vulnerability to heat. Public Health England also published heatwave guidance for teachers and for early years setting in consultation with the department for education. There is also guidance for managing risks from the cold weather through the Cold Weather Plan for England and associated public and professional facing resources. Building on both the heatwave and cold weather plans the aim is to develop a single adverse weather and health plan. Other measures are campaigns to encourage the public to minimize sun exposure by seeking shade or wearing sunscreen.

In terms of infrastructure the department of transportation continues to work with infrastructure managers to extend the provisions for regulating temperatures at stations and on public transport across the country. Network Rail also monitor rail temperatures so that speed restrictions can be imposed should there be a risk of rails moving due to temperature rises. London Underground similarly exercises various precautions including a system for ensuring critical station assets are in good functioning condition prior to hot weather (e.g., cooling systems in control rooms) and has progressively introduced air-conditioned rolling stock on all its sub-surface railway lines. Road surface specifications have also been amended to withstand higher temperatures.

School designs must be modelled against the 2020 Design Summer Year, which ensures greater resilience against increased summertime temperatures, additionally designs for new prisons are to be future proofed to the predicted changes in temperature, windfall, and rain within the Prison Estate Transformation Programme (PETP) modelling. This aims to ensure that summertime overheating is not a significant problem, and that the energy used by future cooling demands is minimised through the design stage. On the existing prison estate both natural (solar shading and natural cooling) and mechanical means (building management systems and thermostatic controls) are used to control temperature and guard against overheating. Adaptation measures, particularly thermal monitoring, and numbers of risk assessments for overheating events, will be incorporated into the Model Hospital to allow benchmarking of performance. To ensure that we all benefit from cleaner, warmer, and comfier buildings, it is critical to improve the energy efficiency of buildings and products, end the use of fossil fuel heating systems and switch to low carbon sources, and integrate the use of smart technologies that give more control to consumers.

To ensure individuals have comfortable homes the government are upgrading fuel poor homes to EPC Band C by 2030 where reasonably practicable and provide additional funding to the Home Upgrade Grant and the Social Housing Decarbonisation Fund by investing £1.75 billon. They will also set long-term regulatory standards to upgrade privately rented homes to EPC C by 2028 and considering setting a long-term regulatory standard for Social Housing subject to consultation. There will be a reduction in bills through a fabric first approach to improving building thermal efficiency (e.g., insulation, draught proofing and increasing energy performance of products and appliances). They are also implementing measures to ensure homes and buildings and well ventilated and protected against rising temperatures. There are also building regulations to set minimum water efficiency standards for new housing, ensure structural stability and limit heat gain.

The Natural Health Service Programme in Scotland supports the health sector to embrace green exercise; as part of health promotion and improvement and encourage healthier lifestyle behaviours – leisure and other outdoor activities may be taken up autonomously as the climate warms. There s specific action to help people form inactive, disadvantaged ad other under-represented groups enjoy the well-being benefits from being outdoors in nature. Another measure in place to tackle hot temperatures is the introduction of free water refills in public places that not only increases customers appreciation of Scotlands tap water but also reduces the use of single use plastic bottles.

In Scotland the Fire and Rescue Service (SFRS) offer free Home Fire Safety Visits, primarily focused on vulnerable citizens. These staff are trained to look for signs of loneliness, fragility, potential slips, trips and falls, signs of drug addiction and / or alcoholism and general health risks.

In Scotland individual adaptation behaviours that are encouraged are staying safe in the sun (suitable clothing, sunglasses, avoid burning and take care with children and use at least SPF 15 sunscreen) and to be aware of pollen and pollution levels which result from changing weather patterns.

1. **Natural carbon sinks/land conservation**

Actions that restore and protect natural sites which also act as natural carbon sinks. The government continue to maintain and restore the condition of protected natural sites, this includes active partnerships with major landowners and other stakeholders (e.g., farmers, conservation organisations) to deliver a programme of improvements for protected sites. There are also networks that have been established including the Protected sites networks (a nature conservation tool), the Nature Recover Network (an expanding network of wildfire habitat to link existing protected sites and landscapes more effectively – also takes a targeted approach within the wider fabric of our countryside and urban areas to create both an improved buffer between and better connect our protected and local sites – to deliver more joined up sites for nature that are better able to adapt to the challenges they fac e.g., flood protection and water quality) and the development of ecological networks.

Another major endeavor is to strengthen the UK’s peatlands. This has included introducing measures such as the Peatland Code, peatland restoration through agri-environment schemes, area designations and targets for the reduction of peat use in horticulture. A Peat Strategy will be published in later 2018 and the peatland grant scheme commenced in April 2018. The grant scheme will be spent on four peatland restoration projects over 3 years and will improve the condition of 6,580 hectares of upland and lowland peatlands in England thereby reducing carbon emissions and delivering multiple environmental benefits. The government will also boost the existing £640 million Nature for Climate Fund with a further £124 million of new money, ensuring total spend of more than £750 million by 2025 on peat restoration, woodland creation, and management. This will enable more opportunities for farmers and landowners to support net xero through land use change. Using the Nature for Climate Fund they aim to restore approximately 280,000 hectares of peatland in England by 2050. There is also a new ambitious framework for peat restoration in England covering both upland and lowland peat; where taking lowland peat soils out of production and restoration to semi-natural habitats is not the preferred option, the government will develop new sustainable management measures to ensure that the topsoil is retained for as long as possible and greenhouse gas emissions are reduced. The government also aim to end peat use in horticultural products by 2030, by continuing to work with the horticultural industry to support their transition to peat alternatives.

More generally there is action to restore natural processes, soils, and hydrology. For example, ensuring healthier soils by addressing the causes of soil degradation such as erosion, compaction, and the decline in organic matter, and incentivizing good soil management practices through environmental land management schemes.

1. **Marine conservation**

Actions which attempt to protect and conserve the marine environment including designation of marine protected areas and utilizing these conservation zones as a network of habitats to aid the movement of species affected by climate change and decrease threats (e.g., overfishing). The Foreign and Commonwealth Office continue to work to create a Blue Belt around the UK’s 14 Overseas Territories, subject to local support and environmental need. This also includes introducing a sustainable fisheries policy as we leave the Common Fisheries Policy and prepare marine plans that include policies for climate adaptation, e.g., the new Fisheries Bill which will ensure sustainable use of fish stocks, a healthy marine environment, and a prosperous fishing industry. The government also continue to collaborate with selected marine sectors through the “climate smart” working initiative to develop adaptive capacity and aim to improve understanding of and responses to climate change impacts on water-borne pathogens and harmful algal blooms. Additionally, Offshore wind developers/operators, offshore transmission operators, turbine manufacturers, foundation fabricators, offshore transmission equipment manufacturers and installers are required to consider and evaluate the impacts of the marine environment on the operating life of their equipment. There is also blue economy (“sustainable use of ocean resources for economic growth, improved livelihoods, and jobs while preserving the health of ocean ecosystems” World Bank) and the use of coastal fjords as sinks for carbon.

In Scotland the farmed fish health framework: climate change and ocean acidification subgroup aim to support aquaculture business to adapt by monitoring, reviewing and assessing the impact of climate change and ocean acidification on Scottish waters. The National Marine plan also highlights that fisheries will be managed considering changes in species distribution and abundance due to climate change.

1. **Business and Industry**

Actions that have or need to be taken by business and industry that do not fall into any of the categories above. Green finance, defined as the mobilization of private investment in environmental and sustainable projects and infrastructure is essential to meeting the UK’s domestic and international climate change commitments. The government has endorsed the recommendations of the Taskforce on Climate-related Financial Disclosures (TCFD) and has encouraged all listed companies to implement them. The Green Finance taskforce recommendations are: 1) Relaunch UK green finance activities through a new unified brand; 2) improve climate risk management with advanced data and analytics; 3) implement the recommendations of the Task Force on Climate-Related Financial Disclosures (TCFD); 4) drive demand and supply for green lending products; 5) boost investment into innovative clean technology; 6) clarify investor roles and responsibilities; 7) issue a sovereign green bond; 8. build a green and resilient infrastructure pipeline; 9) foster inclusive prosperity by supporting local actors; and 10) integrate resilience into the green finance agenda. The government has also commissioned the British Standards Institution to develop the world’s first green and sustainable finance management standards.

Another strand is the UK’s openness to trade combined with a robust domestic production sector has brought a very impressive diversity to UK food supply, and this will continue after we leave the EU. The UK imports food from over 180 countries and this openness ensure that UK food supply is very resilient to supply interruptions from specific countries and from disruption to domestic UK production. Retailers and large food service operators can switch sources of supply rapidly if required.

The Scottish government are committed to providing support to small and medium sized businesses to reduce their energy consumption and resource costs and to encourage the uptake of renewable technologies via loan funds and support services. Additionally, the Scottish government have developed a fair work charter for severe weather to support employers to plan for and manage the impacts of severe weather conditions on workers and their business. There is also the climate ready business guidance which provides guidance on how business can ensure their supply chains are adaptable to the changing climate. The Scottish Environment Business Awards also celebrates and showcases Scottish businesses which are taking significant steps to reduce their impact on the environment and support the wider goals of sustainable development.

1. **Waste**

The government aim to reduce emissions from the energy from waste sector – emissions from energy from waste plants represent a significant part of the residual emissions in the power sector. The Government’s Resources and Waste Strategy (RWS) set out the overall ambition and direction of travel for the waste sector. It made a commitment to increase municipal recycling rates to 65% and to ensure that no more than 10% of municipal waste is landfilled by 2035. To support their commitment to explore options for the near elimination of biodegradable municipal waste to landfill from 2028, they are bringing forward £295 million of capital funding which will allow local authorities in England to prepare to implement free separate food waste collections for all households from 2025. Consistent collections of household and business waste will be introduced via the Environment Bill. The powers will allow the government to require local authorities to separately collect a core set of materials for recycling, including paper and card, glass, metal, plastic, food waste and household garden waste. Complementing these measures, the introduction of the plastic packaging tax from April 2022 will encourage greater use of recycled plastic in plastic packaging, instead of new (virgin) plastic. The tax will be charged at £200 per tonne and be paid by manufacturers and importers of plastic packaging that contains less than 30% recycled plastic. Scotland is looking to circular economy (sharing, leasing, reusing, repairing, refurbishing and recycling) with ZeroWaste Scotland. The circular economy strategy for Scotland foucsses on innovation, seeking new ways to reduce consumption of natural resources and keep materials flowing through the economy at high value for as long as possible.