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Low Carbon and Climate Change Adaptation Opportunity Assessment

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Inverness

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Executive Summary

Transitioning to a low carbon economy involves making the reduction of carbon emissions from business and public sector activities central to Government economic strategy. It is clear that Scotland is on this pathway having committed to very ambitious climate change targets and produced a Low Carbon Economic Strategy supported by a range of policy interventions, funding streams and associated Government programmes.

To avoid the significant damages and associated economic cost which climate change will bring, it is vital that Scotland not only mitigates but also adapts to climate change and this report highlights key actions for Inverness and the Highlands and Islands Council in that respect.

As recognised by the Scottish Government and the Cities Alliance, Scotland's seven cities have a key role to play in transitioning to a low carbon and adapted economy. The cities provide around 60% of Scotland's jobs and are home to around 50% of its population. While they are therefore a significant contributor to the national emissions, they also present the greatest opportunity to build a more sustainable future for Scotland, to demonstrate leadership and to capitalise on the opportunities available.

It is the objective of this report to consider how best Inverness can participate in this process. The report aims to provide a high level and indicative assessment of the potential benefits of targeted actions, both in term of carbon reduction, jobs and broader economic development. This report sits alongside a City Report for each of the other six Scottish cities, and an Overview and Collaboration Report which looks at the potential benefits across all seven cities and considers what can be provided by collaboration amongst the cities.

While Inverness is actively pursuing the low carbon agenda through actions such the Carbon Clever project, it is the recommendation of this report that to accelerate and further advance this agenda locally to deliver carbon savings and local economic development with direct employment benefits, Inverness should as a priority:

1. Replace or upgrade all street lights with more efficient and low carbon LED lighting;
2. Retrofit energy efficiency measures within the City Estate (public sector); and
3. Expand the green transport infrastructure network.

Inverness is making progress in these activities, but the recommendations represent a significant increase in scale. The combined capital cost of these three actions is estimated at £16.4 million. The total estimated carbon saving is almost 4.6ktCO_2e per year; roughly equivalent to 1% of Highland Councils annual emissions' while also saving £1.2 million per year from operational expense. A significant by-product of implementing these three actions will be the local job and supply chain opportunities. Over a 5 year programme of activity this may support 52 direct full time jobs and a further 85 indirect jobs over that same period; equivalent to 691 job years of employment.

Inverness is home to 60% of the Highland population and is a city where tourism contributes significantly to the local. Inverness is leading the Carbon CLEVER initiative which has the target of a carbon neutral Inverness in a low carbon Highlands by 2025; it is adopting the 'Smart City' programme and is building a reputation as “Scotland’s Cycling City”. Inverness also faces significant risks from climate change with projections suggesting that a 21% reduction in water availability during dry periods projected by the 2050s could impact the water supply for Inverness. In addition, the severity of all types of flooding, fluvial, surface water (pluvial) and coastal flooding is predicted to increase significantly.

In addition therefore to the mitigation actions outlined above, it is recommended that Inverness actively pursue adaptation actions including:

1. The development of Sustainable Building Standards, in conjunction with the development planning process;
2. Investigation of a retrofitting programme for Sustainable Urban Drainage (SUDs) measures to existing development; and
3. Review Council owned premises and operations to determine their vulnerability to storms and high winds; encouraging others in the city to do the same.

It is widely accepted that the current Scottish Government proposals and policies for transitioning Scotland to a low carbon economy and becoming more resilient are extensive, with an associated support network of organisations available. However, a range of practical challenges remain for Inverness and Highland Council, which are largely focused in three areas:

- Leadership and senior level sponsorship to drive and support projects;
- Capacity and capability limitations where people are already overstretched and do not have the technical or business case development capabilities required; and
- Development funding to get projects to a position where they are ‘investment ready’.

A collaborative approach to driving change is required and will deliver significant value over an approach that sees the cities working in isolation. So while Inverness has experience to share more widely to support change elsewhere; the city could also benefit from others experiences and expertise. These and other issues are discussed in greater detail in the Overview and Collaboration Report.

The Context

A low carbon economy is one that makes the reduction of carbon emissions from business activities central to a government's economic strategy. Scotland, with its ambitious Climate Change targets, is currently transitioning to be such a low carbon economy.

This transition presents a win-win strategy as it boosts the country's economic development and also serves to contribute to the mitigation of potential economic losses from global climate change.

The Earth's climate has changed repeatedly in the past; however, three things make the current situation different. Firstly, there is overwhelming scientific evidence to suggest that the changes we are experiencing now are largely attributable to human activity. Secondly, the scale of change is greater than has been experienced for many hundreds of thousands of years. Thirdly, these changes are happening at what many believe to be an unprecedented rate.

The Scottish Government recognises the issues this brings and accordingly it has put in place world leading legislation that will help tackle the problems these changes are bringing, and drive us towards the development of a resilient low carbon economy.

Cities have an important role to play in supporting the transition to a low carbon and resilient economy. Around 50% of Scotland's population live in and around its seven cities and around 60% of Scotland's jobs are located in cities. Scotland's cities contribute significantly to the country's carbon emissions.

See Box 1 for details of what other cities say about the benefits of a low carbon movement.

Box 1: Climate Change - What do other cities say?

The Carbon Disclosure Project[1] Cities programme gathers views from global cities on an annual basis. The key messages from the 2013 report were:

1. Climate change action is making cities leaner and richer. Half of the actions that cities are taking to reduce emissions in their municipal operations are focused on efficiency.
2. Emissions reduction activities by cities are pro-business. 62% of actions that cities are taking to reduce GHG emissions at the city-wide level have the potential to attract new business investment and grow the economy. 91% of cities say climate change presents an economic opportunity.
3. Reducing emissions and adapting to climate change makes for healthier citizens.

As cities act as a catalyst to deliver wider benefits for the city regions and for Scotland as a whole, they also present the greatest opportunities to build the more sustainable future that will position Scotland at the forefront of a low carbon industrial revolution and in delivering a more energy and resource efficient environment that enhances the quality of life for those who live and work within and around them.

There must also be recognition of the potential for synergies in decarbonisation activity and climate adaptation actions which are currently being delivered in the cities. In respect of adaptation activity, which has had less prominence than mitigation activities, it is important to note that the Government sees these as parallel activities, as noted in Scotland's first statutory Climate Change Adaptation Programme[2]:

> *"Preparing effectively for unavoidable climate change and reducing emissions are both essential actions if we are to ensure sustainable economic growth in Scotland – the overarching purpose of the Scottish Government"*
>
> Paul Wheelhouse;
>
> Minister for Environment and Climate

There is a strong policy backdrop which supports and encourages action by the cities on climate change. The responsibility of cities, and their partners, has been confirmed within the Scottish Climate Change Declaration[3], signed by the Highland Council in 2007, and within a number of the priority areas in the Highlands Single Outcome Agreement[4]. Additionally, under the Public Bodies Duties element of the Climate Change (Scotland) Act 2009, public bodies, including all the cities, are required to act to support the delivery of Scotland's targets for both emissions reduction and adaptation, and in a sustainable manner. This array of policy constitutes a very strong set of drivers for the cities.

The impacts posed by the changing climate, along with the policy drivers in Scotland, pose many challenges for those who manage and inhabit its cities. However, they also present significant opportunities for employment generation, skills development, business growth and innovation. It is these opportunities which are the focus of this study, both in terms of climate change adaptation and mitigation.

The Scottish Cities Alliance (SCA), which has commissioned this study, is the collaboration of Scotland's seven cities, the Scottish Government and the Scottish Council for Development and Industry (SCDI). Scotland's cities are Aberdeen, Dundee, Edinburgh, Glasgow, Inverness, Perth and Stirling. The group is tasked with the collective aim of attracting external investment, stimulating economic activity, and creating new jobs and business opportunities and driving stronger City collaboration. It is against this backdrop that this project has been commissioned.

A recent report on Sustainable Cities[5] concluded that greater and 'smarter' collaboration and partnership between the public and private sectors and between the cities themselves will be critical to successfully addressing this challenge. Isolated initiatives which 'reinvent the wheel' and fail to draw on the full spectrum of skills and resources available will be wasteful of resources and will fall short of objectives.

The success of Inverness in growing a low carbon economy is in part dependent upon its own actions but also on external factors upon which the City has no direct control; market and political conditions among them. Some issues which are currently on the horizon which may influence the economics of low carbon activities or the broader choices that are made relating to this include:

- Electricity Market Reform and the impact it may have on new generation, supply chains, electricity prices and grid carbon intensity;
- The market price of carbon;
- Gas prices, which may be influenced by geopolitical factors and government policy. The relative price of gas to electricity (known as the spark-gap) is important for the economic viability of various technologies, especially combined heat and power;
- Scotland's political environment, including the level to which Scotland has control of energy policy;
- Changes to incentives for low carbon generation; and
- Draft Heat Generation Policy Statement may provide impetus to energy efficiency, district heating and renewable heat initiatives.

Consideration of these future changes is provided as appropriate within the discussion around recommended actions later in the report.

Some key terms used within this report are defined in Box 2.

Box 2: Key Terms

For clarification the following key terms which are used extensively in this report are defined here, as defined by the Intergovernmental Panel on Climate Change[6]:

Adaptation: Changing how we operate in response to actual or expected climatic changes or their effects, which moderates harm or exploits opportunities.

Resilience: the ability to absorb disturbances while retaining the same basic structure and ways of functioning, the capacity for self-organisation, and the capacity to adapt to stress and change.

Mitigation: An intervention to reduce human induced impacts on climate systems; it includes strategies to reduce greenhouse gas sources and emissions and enhancing greenhouse gas sinks.

The Project

The 'Stern Review on the Economics of Climate Change'[7] in 2006 discusses the effect of climate change on the world economy. The Review states:

'Using the results from formal economic models, the Review estimates that if we don't act, the overall costs and risks of climate change will be equivalent to losing at least 5% of global GDP each year, now and forever. If a wider range of risks and impacts is taken into account, the estimates of damage could rise to 20% of GDP or more. In contrast, the costs of action – reducing greenhouse gas emissions to avoid the worst impacts of climate change – can be limited to around 1% of global GDP each year. The investment that takes place in the next 10-20 years will have a profound effect on the climate in the second half of this century and in the next.'

In summary, the main conclusion is that the benefits of strong, early action on climate change far outweigh the costs of not acting. We are currently in the middle of that unique window for action.

The scope of this review covers all of Scotland's seven cities and includes the identification of potential economic risks and opportunities arising from climate change and the low carbon agenda. It will provide a high level and indicative assessment of the economic risks of potential climate change impacts at the local city level, and the economic and employment benefits from actively pursuing the Scottish Government's low carbon and adaptation agendas for each city.

As part of this study but reported separately, the collaboration opportunities across cities are considered, along with the implications of the study's recommendations for the city and national economies. The outputs of this assessment are provided in a summary report detailing the actions which could be taken across all the cities, identifying collaborative opportunities and considering the economic value that could be delivered as a result.

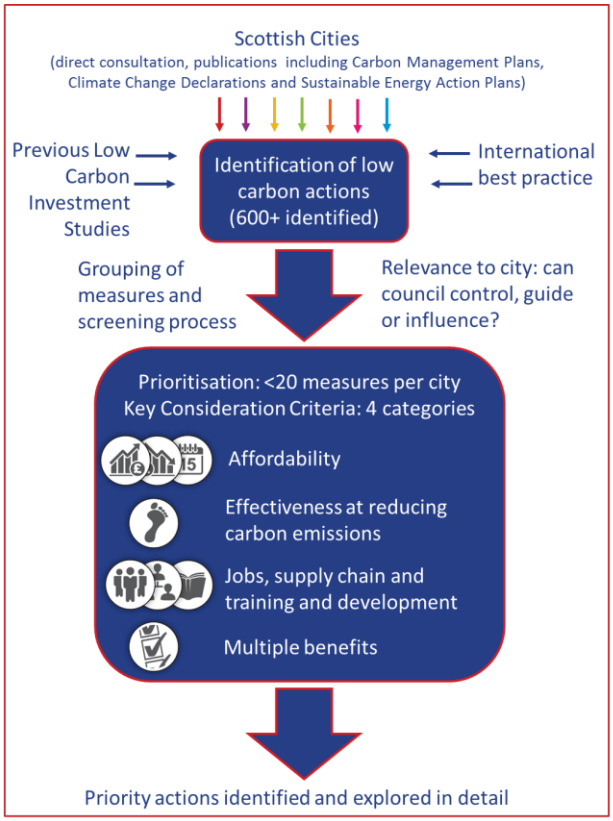
This study considered a very wide range of possible actions; in line with the proposals set out in 'Low Carbon Scotland - the Scottish Government's Second Report on Proposal and Policies' (RPP2)[8]. These include actions in relation to decarbonising energy generation, developing sustainable homes and communities, supporting efficiencies in business and industry, and better managing transport and waste.

It will be necessary to undertake a wide range of actions in order to achieve the climate change targets set by the Scottish Government. These targets are emissions reduction of 42% by 2020 and 80% by 2050. Actions will also be required to adapt to the changing climate. Many of the required actions are already happening across the country, however, it must be recognised that there is no silver bullet available to the cities to achieve the targets and adapt their cities.

In keeping with the aims of the SCA, the focus for this study is on those actions which both individually and collaboratively support economic development, provide employment and skills development opportunities, and address the cities' needs in terms of mitigation and adaptation in the short to medium term. An exercise has been performed to identify, screen and prioritise these opportunities, as illustrated by Figure 1.

The actions prioritised by this process are discussed in detail under Decarbonising Inverness' Economy later in this report.

Figure 1: Identification and prioritisation of actions



It is noted that the three prioritised actions are primarily mitigation rather than adaptation measures. This is partially due to current activity being underway to identify and develop adaptation actions as part of the Local Flood Management Plans. Adaptation actions also tend to be very location specific in terms of their economic outcomes such as capital cost and jobs, and aside from large infrastructure projects such as flood defence schemes they do not tend to directly deliver significant jobs and economic development in the short to near term. However, this should in no way diminish the importance or the urgency required for implementing adaptation actions, as discussed under Adaptation and Resilience.

Outside the prioritised actions, further detail on the transition to a low carbon economy in Inverness and across the Highlands can be found in the supporting documents of the Carbon CLEVER initiative[9].

What is not included in this project?

Given the complexities associated with this agenda and for the avoidance of confusion, it is explicitly stated that the project does not attempt to:

- Quantify the total value of the low carbon economy to Stirling;
- Estimate the total costs to the economy of inaction on climate change;
- Produce a business case for each of the prioritised actions recommended for the city;
- Consider in detail how weather changes in other parts of the world associated with climate change may lead to consequential impacts felt in Stirling;
- Quantify how much should be spent on climate change mitigation to avoid the worst impacts of climate change (unlike the original Stern review); or
- Target a particular level of carbon emissions reduction.

It is also highlighted that, despite flooding being a major risk associated with climate change, this report is not a flooding study. The development of the scope of this project has been guided by the goals and objectives of the SCA, with a focus on actions and implementation.

The City

Capital of the Highlands, Inverness, is located on the mouth of the River Ness. Characteristics of Inverness are provided below[10]

Inverness

- Population of 67,230.
- 60% of Highland population live in or around Inverness.

Education

- Students total 4,900 in Highland.
- 58% of Highland reached NVQ3 level of educational attainment.
- Only 6% have no qualifications at all.
- Inverness College, central campus for the University of the Highlands & Islands.

Employment

- 78% of the Highland population are economically active.
- Unemployment is less than the national average at 5.8%.
- Largest number of employees work as a manager, director, senior official, professional occupation, associate professional or technical.

Key Economic Sectors

- The city is home to the Scottish Natural Heritage providing a large number of jobs.
- Production sector contributes 24% Gross Value Added (GVA).
- Highland tourism action plan will help growth in the tourism sector.

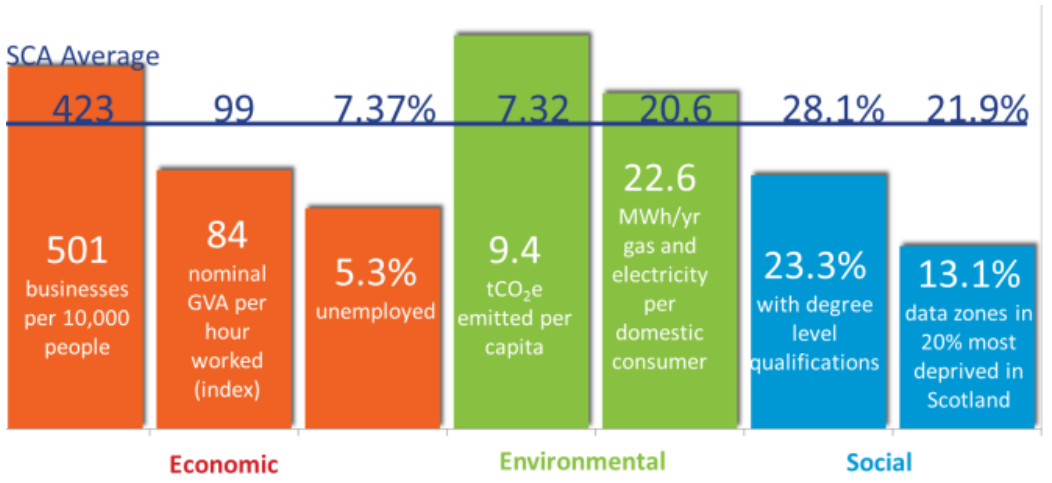
Tourism

- Visitors come to Inverness because of the cities natural and cultural heritage.
- Tourism generates almost £740m of direct expenditure (£174 indirect).
- It supports 20,000 jobs (2012).

Carbon Neutral Inverness

- Carbon CLEVER is an initiative which has the target of a carbon neutral Inverness in a low carbon Highlands by 2025.
- Inverness is adopting the 'Smart City' programme.
- Building a reputation as “Scotland’s Cycling City”.

Figure 2: Inverness and Highland indicators

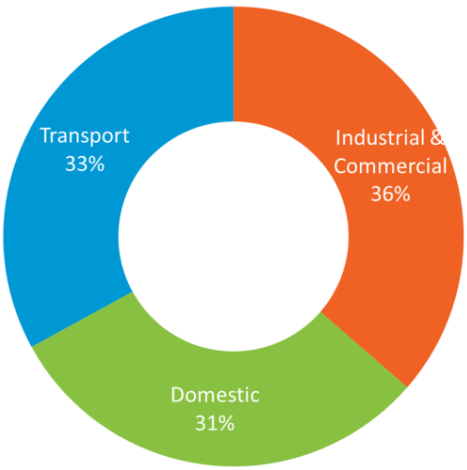


Source: Data taken from ONS and DECC sources, note that for most indicators data is only available for regions larger than Inverness. For most indicators this is the Highland Council area

Figure 2 presents a range of economic, environmental and social indicators for Inverness, benchmarked against the Scottish cities average[11]. Statistics relating to energy use and carbon emissions are published according to local authority boundaries. This presents a challenge when trying to make meaningful comparisons between cities such as Inverness, which is part of a much larger local authority, and cities where the whole local authority area is highly urbanised. This is reflected in the per capita emissions for Highland area, which are around 2tCO_2e higher than the seven city average, with greater travel distances and heating resulting in additional carbon.

Energy use in the Highland Council area is split fairly evenly across the three sectors; industrial & commercial, transport and domestic as shown in Figure 3.

Figure 3: Highlands energy use by sector

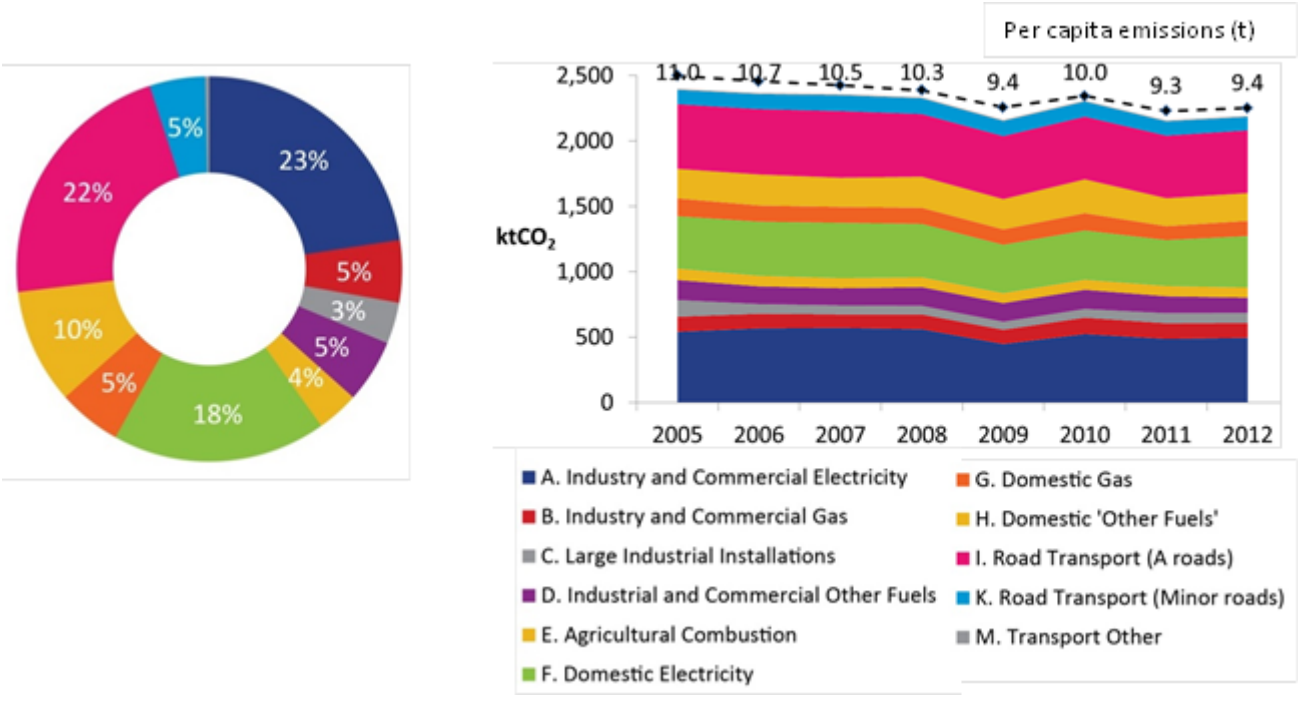


Source: DECC Sub-national total final energy consumption in the United Kingdom [12]

Figure 4 provides sector carbon emissions data for the Highland Council area. As previously noted, the conclusions that can be drawn for the city of Inverness from this data are limited, as Highland includes such a large rural area. This figure shows the 2012 emissions data for each sector in percentage terms, with road transport representing the largest source of emissions. It also shows trends in emissions between 2005 and 2012, which has an overall downward trend, influenced by grid decarbonisation, lower emission transport fuels and changes in economic activity.

There are year on year decreases except in 2010 and 2012 where there are small increases, which are linked to the cold winters experienced in those years. Highland per capita emissions show a decreasing trend, which at 9.4tCO_2e is significantly above average for Scotland (6.8tCO_2e) and the UK (6.9tCO_2e, 2011). Given the low population density and significant road travel required this is not unexpected. It should also be noted that the *emissions within the scope of influence of Local Authorities* data published by DECC excludes emissions due to "Land Use, Land-Use Change and Forestry Sector Emissions" (LULUCF). The carbon sinks within Highland are significant, and including these figures reduced the per capita emissions to 1.5tCO_2e.

Figure 4: Highland CO_2 emissions by sector; showing 2012 and the trend since 2005



Source: DECC CO_2 emissions within the scope of influence of Local Authorities, 2005-2012

In assessing the There is not a single publically available source to consistently compare the emissions of different organisations, who when reporting their footprints use different boundary definitions (in terms of emission sources, geographical and organisational boundaries). Therefore the values in Table 1 cannot be considered fully comprehensive, but they do give an indication of the largest emitters in the city. Table 1 below shows the most recent emissions from Highland Council and NHS Highland.

Table 1: Inverness' largest CO_2 emitters

Organisation	Carbon Footprint and Context
Highland Local Authority [a]	• 58,128tCO_2e (2011/12), including Energy use in buildings; Staff travel; Fleet; Internal waste; Street lighting; and Water. • Reduction of 9.3% compared to the previous year.
NHS Highland [b]	• 13,158tCO_2e (2012). • This includes all Highland Council, with approximately 15 sites, only 3 of which are in Inverness.

[a] Highland Council 5 Year Climate Declaration Report, available online at the SSN website.

[b] Heat Facilities Scotland HEAT Target Report

The Vision

Inverness' vision is for the city to become a "place where individuals, communities and businesses are able to realise their full potential and fulfil ambitions that benefit them, their city and the wider region", as stated in their city investment plan.

City Investment Plan

- Strengthening the city centre making it a more attractive desirable place for businesses to locate;
- Improving connectivity in terms of transport and IT;
- Building on existing assets by protecting and strengthening what already exists to enhance the rich and diverse culture;
- Increasing tourism focus by encouraging and supporting appropriate tourist destinations; and
- Increasing culture, pride and identity.

Investment priorities are also part of Inverness's City Vision[13] for shaping the future of the city. Overall it points to a number of key themes which will guide how Inverness will grow. These include; a better connected Inverness; GreenNess; and think tourism.

As signatories to Scotland's Climate Change Declaration (CCD), Highland Council is committed to taking action across a range of key areas.

Climate Change Declaration

- Providing effective leadership, governance and management on climate change;
- Reducing the local authority's own 'corporate' greenhouse gas emissions from their estate, services and functions;
- Taking action to reduce emissions from the local authority area;
- Assessing the risks of climate change impacts and working with others to adapt to the impacts of climate change; and
- Developing effective partnership working and climate change communications.

The Highland Council has taken the challenges laid down in the Climate Change Declaration and developed Carbon CLEVER, which has the target of a carbon neutral Inverness in a low carbon Highlands by 2025. This builds on the Highland Council's Carbon Management Plan, but transforms it in scale, pace and ambition. Instead of working towards incremental change, Carbon CLEVER is looking to facilitate a fundamental change in how Highland businesses, organisations, communities, and residents use energy in their homes, buildings and transport. It will affect how waste is dealt with, land use planning, environmental education and support economic growth. It presents opportunities for new ways of engaging with communities and for partnership working regionally, nationally and internationally.

Adaptation and Resilience

As the Stern Review states:

'Adaptation will be crucial in reducing vulnerability to climate change and is the only way to cope with the impacts that are inevitable over the next few decades'.

Adaptation is about building resilience to the unavoidable consequences of a changing climate and addressing impacts which are already locked in and unlikely to be mitigated by actions to reduce emissions. This is done firstly through identifying climate change impacts across a range of sectors, minimising the negative effects though the use of mitigation and planning, and responding appropriately. In responding to these adaptation needs, both the risks and opportunities arising from climate change must be recognised and planned for.

The Scottish Government's Climate Change Adaptation Programme addresses the impact identified for Scotland in the UK Climate Change Risk Assessment and sets out a programme for addressing these risks. These risks include increased flooding: Scotland's National Flood Risk Assessment estimated that one in 22 of all residential properties and one in 13 of all commercial properties in Scotland are already at risk from flooding, without taking climate change into account[14].

The National Flood Risk assessment for Scotland estimated that the average annual damage to homes, businesses and agriculture from all sources of flooding is between £720m and £850m. In addition to the personal distress and health impacts of flooding, this represents a significant impact on the Scottish economy. The recent storm surges and extreme weather in the winter of 2013 resulted in the River Ness breaching its banks in the city centre and caused major disruptions throughout the region.

It is known that the socio-economic benefits of adaptation to river flooding caused by climate change far outweigh the costs to do so, with the potential for adaptation measures to save £42.2 billion every year in flood-related losses across Europe by 2080[15]. The River Ness flood alleviation scheme will deliver benefits in the region of £83m, with a cost benefit ratio of 3.5.

Notice should, therefore, be taken of the significant impacts which could result if there is a failure to act and reduce the risks to our cities, like Inverness. However, in doing so, opportunities for employment and other environmental and social benefits will arise, both through the creation of better 'places' and the associated social and economic benefits, and the provision of employment and skills development opportunities in the delivery of the required infrastructure.

The City Projections

The climate change risks and opportunities for Inverness and the Highlands have been detailed in 'Adapting to Climate Change in Highland 2012'. The risk and opportunities identified largely mirror those developed as part of this project, where city specific climate change projections have been developed based on the UKCP09[16] projections.

These represent the most up to date comprehensive suite of climate change projections readily available for the UK. However, in a number of cases additional understandings, published after the release of UKCP09, are also referred to and used to refine the projections for each city. Most notable in this respect is the use of the IPCC 5th Assessment Report to revise sea-level rise projections.

Table 2: Climate impact projections

Climate Impact Category	Summary of Climatic Impact Projection for INVERNESS	Change by 2050's
Sea level rise	Increase in extreme tide levels	↑ 0.24m
Fluvial flooding	Increase in severity of 1:100 annual chance flood event	↑ 1:190 severity
Pluvial flooding	Increase in severity of 1:100 annual chance flood event	↑ 1:220 severity
Drought	Reduction in hydrological water availability (high vulnerability)	↓ 21%
Storms and High winds	Potential increase in severity of 1:20 annual chance extreme gust (Projections less well understood)	↑ 1:50 severity
Heat wave	Potential increase in the chance of a heatwave in any one year from almost negligible at present to	↑ 1 in 12
Extreme cold spell	Reduction in number of frost days per year Reduction in number of heating degree days per year	↓ 29 ↓ 47
Tourist/ growing season	Increase in summer growing (tourist) season days. Reduction in winter period days	↑ 35 ↓ 30-50

Significant Negative Impact | Noticeable Negative Impact | Some Positive Impacts

Notes on Table 2:

1. The negative Impacts have been categorised into *Significant* and *Noticeable* on the basis of the scale of the impacts, as explored in this section. This is a function of both the climate projections and the infrastructure in the city, and it is acknowledged that there is a degree of subjectivity in this categorisation. The impacts that are expected to lead to some benefits are labelled *Some Positive Impacts* to recognise that these changes are also likely to have negative consequences for human and natural systems that are adjusted to the existing climate.
2. For fluvial and pluvial flooding and storms the change in severity by the 2050s is shown by giving the increased severity of the 'at present' baseline event in the 2050s expressed in terms of annual probability. For example, a 1:100 annual probability Pluvial Flooding event in the 2050s is projected to have the equivalent severity to a 1:220 annual probability Fluvial Event today.
3. While rainfall seasonality has been accounted for in the consideration of drought, seasonal changes to high intensity storm rainfall related to flooding and the integrity of building infrastructure would require more detailed assessment beyond the scope of this present study.

The projections are based on the 2050s time horizon for the medium emission scenario and are the central 50 percentile estimates from the probabilistic projections. It should be noted that the projections associated with storms and high winds are considered to be very uncertain. For more detail on the methodology behind these projections please see Appendix A. A summary of the climatic projections for Inverness is presented in Table 2.

Locally, the climate projections indicate that Inverness can expect sea levels to increase by 0.24m by the 2050s. Extreme high tide levels will increase by just as much as average sea levels, but in addition this could be exacerbated by an increase in the frequency or severity of tidal surges associated with extreme weather.

There is a risk posed to water supply for Inverness, with a 21% reduction in water availability during dry periods projected by the 2050s. The current water supply system is located to source high quality water which requires less energy intensive treatment than other sources, such as from Loch Ness. Therefore although there are sufficient water resources, there could be a high vulnerability to dry periods without further resilience built into the supply infrastructure. It should also be noted that water availability can in some circumstances also be impacted by flood events.

In addition, the severity of all types of flooding, fluvial, surface water (pluvial) and coastal flooding, is predicted to increase significantly, with the chance of an extreme event (for example a 1:10, 1:50 or 1:100 annual chance event or above) happening in any given year more than doubling by the 2050s in addition to sea level rise. This increases the risk of properties flooding (both commercial and residential), as shown in Figures 5 and 6 (the 1:100 annual chance event is used as an example to illustrate the change). However, the city projections also identify increased risks from flooding on the city's transport network; with a possible 50% increase in kilometres of road at risk by the 2050s (7 additional kilometres). See Appendices A and B for details. Note that the basis for this assessment has had to adopt a more severe baseline flood event and assumed change up to the 2050s due to data availability limitations.

It is noted that no new flood modelling has been undertaken for this study, which rather than being a study focussed solely on flooding is concerned with a range of climate change and economic development issues. The results presented in this section are based upon the interpolation of existing national scale flood modelling datasets provided by SEPA. Therefore the results are subject to the same limitations as the national scale datasets[17].

Projection of increased temperatures may result in some perceived benefits, with projected reductions in heating degree days (14%) and frost days (48%) in Inverness, along with an increase in the summer growing season (by 23%), however, these changes may not universally be regarded as benefits. Clearly these changes could also bring negative impacts associated with altered natural environments and changes in the distribution of species and habitats.

Increased temperature projections, however, also mean that there is an increased risk of heatwaves. For all cities this could be significant and have implications for health and well-being possibly resulting in increased mortality rates associated with heatwaves and increased costs for health services. The analysis of the UKCP09 data suggests that Glasgow, Stirling and Perth may be more affected by this than the other cities.

Figure 5: Commercial properties flood risk map (Baseline and 2050s)

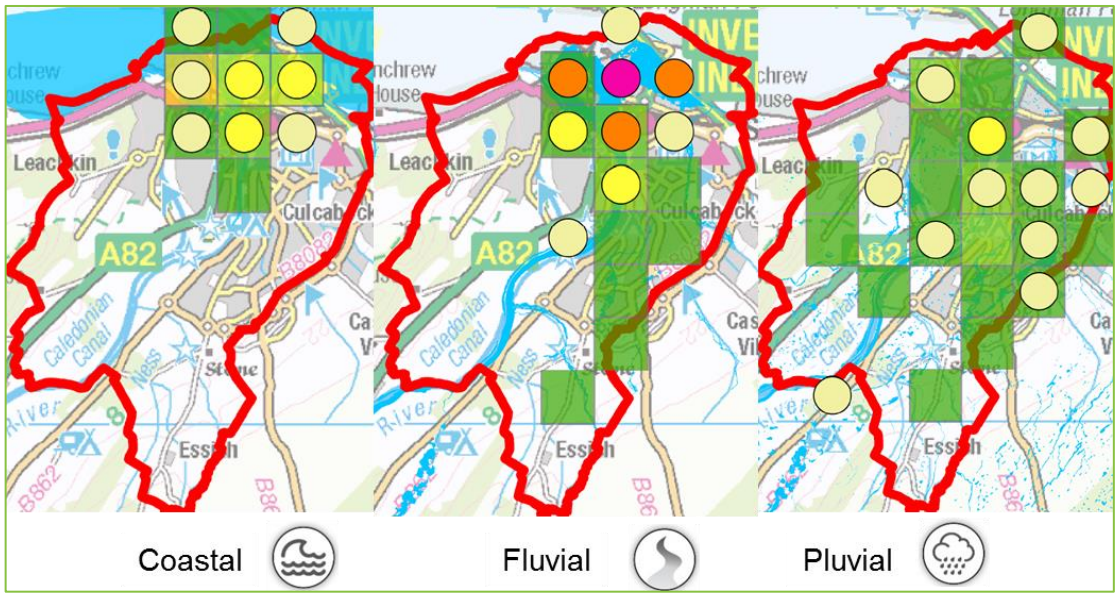
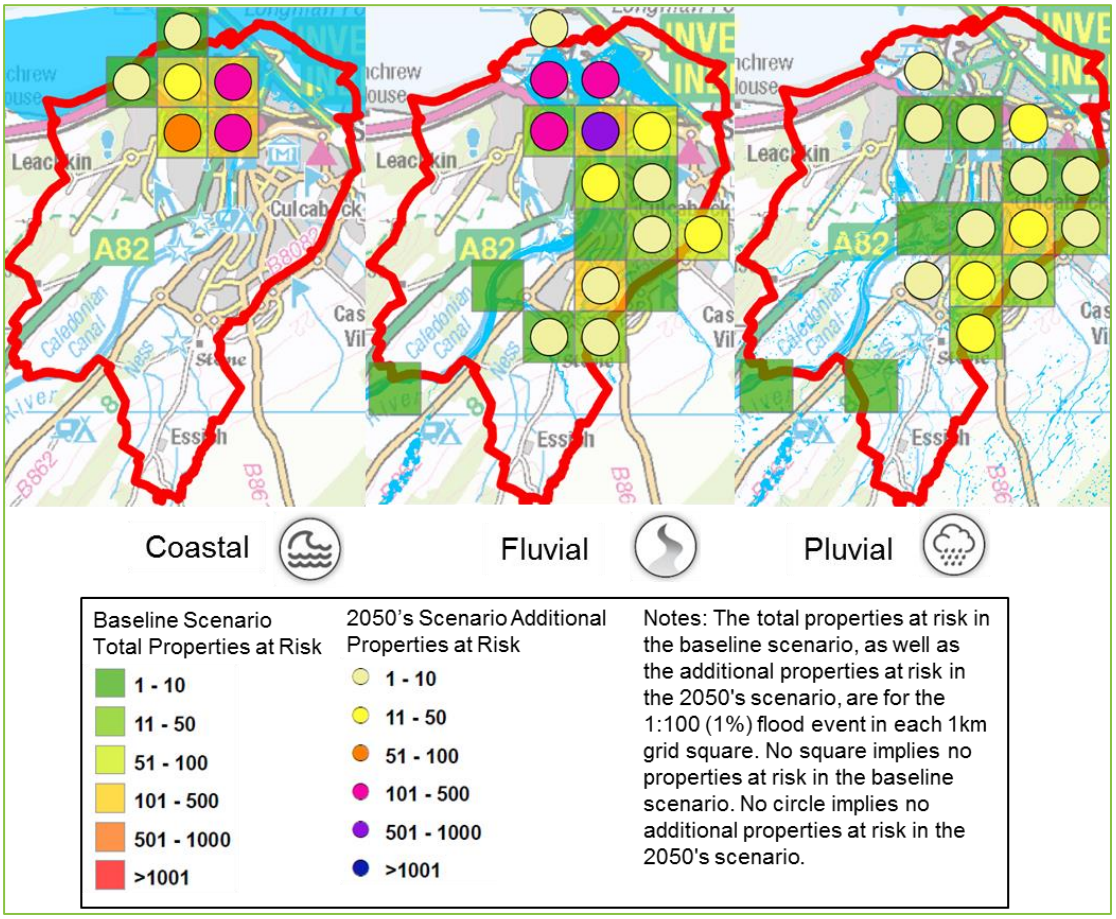


Figure 6: Residential properties flood risk map (Baseline and 2050s)



Maps are based interpolated estimates and do not imply a high level of accuracy. Legend applies to both Figure 5 and Figure 6. See Appendix B for further details of analysis and data sources.

Impacts on Sectors

Many of the impacts associated with the climate projections analyses are expected to affect all economic sectors in Inverness and the Highlands to a similar extent. The impact associated with sea level rise and fluvial flooding is expected to be the most significant negative impacts. Figures 5 and 6 shows the locations where commercial properties are at increased risk from these flood sources by the 2050s. The baseline and additional flood risk by the 2050s is concentrated in the tidal area of the River Ness and to the south east of the city. In total it is expected that around an additional 460 commercial properties will be at risk from extreme fluvial flooding events, with a lower figure (around 100) at increased risk from tidal levels. Note that extreme flooding in that case means floods with a severity equivalent to what is currently considered a 1:100year annual chance flooding event. There may be some overlap with the properties at risk from these two types of flooding.

Unfortunately the data does not allow for distinction between commercial property types and, therefore, it is not possible within this assessment to identify the sectors of the local economy at highest risk from flooding. However the River Ness Flood Alleviation Study[18] estimates that the present value of benefits that will result from the scheme when completed is £86.4m. From this it can be deduced that the total potential damage at risk from flooding must be in excess of £86.4m (in present value terms), as the flood protection scheme will not remove all risks.

Inverness, and the whole Highland economy, is dependent on its transport links to support the continued growth of its population and its economy. The A9 Perth to Inverness Economic Appraisal[19] notes the impact of concerns about remoteness on the economy and the reliance of the growth in the life science sector in Inverness upon access to international travel, where the role of the A9 and Inverness airport are critical. Furthermore, it notes that travel and accessibility are a major issue for local businesses in recruiting and retaining staff. Any increased risk to the city's transport connections from climate change could, therefore, be expected to impact the economic growth aspirations of Inverness across all sectors.

In addition to increased flood risk, the climate projections highlight additional risks of drought for Inverness, which could have significant implications for all sectors of the local economy if not mitigated. This could pose a significant risk to both existing industries and the aspirations for growth within the city.

The reduction in extreme cold spells and, therefore, frost and heating days, is expected to broadly have positive impacts. However, this will not be a universally accepted benefit, particularly for those businesses that rely on winter tourism, such as the ski resorts across the Highlands and associated visitors to Inverness. Currently Inverness spends approximately £5.5m each year on road maintenance, although expenditure varies according to the severity of the winter[20]. A 48% reduction in frost days could, therefore, provide direct significant cost reductions for the Council as well as others.

The reduction in heating degree days is predicted to save around 244GWh/year of energy in domestic heating by 2050 across the Highlands, which could save up to 59,000tCO_2e[21], which would be equivalent to 7.5% of Inverness's expected domestic heating demand in 2050.It can be expected that associated with a reduction in overall number of cold weather days will be reduced health impacts, however, these cannot be quantified based on the analysis completed to date. Increased temperatures in the summer may result in additional costs associated with refrigeration and air-conditioning.

A variation in the impact by sector is expected in relation to the changes to the summer growing season (and, therefore, potentially also the tourist season). The season is predicted to increase by around 35 days, with winter days reducing by around 30 to 50 in Inverness and Highland by the 2050s. This is likely to provide significant positive opportunities for the summer tourism sector, but potential negative impacts for winter tourism. There is also the potential to negatively impact on particular habitats and species or the natural environmental broadly, upon which the tourism sector is heavily reliant.

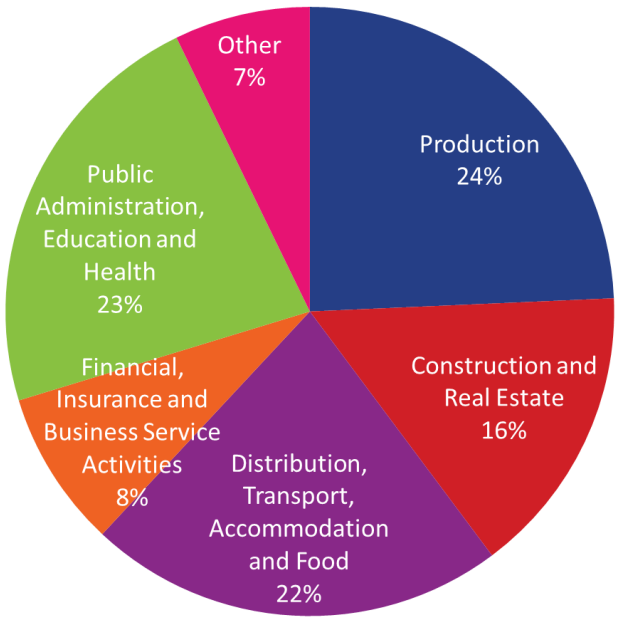
There are around 2.25m staying visitors to Inverness (and the Highlands) per year, of which 390,000 are overseas visitors. In the summer there are approximately 9,750 visits per day. It is estimated that an increase of 40 days of summer would bring in 190,000 extra staying visits generating an additional £27m in direct spend and £11m in indirect expenditure. It has not been possible to carry out analysis on the likely impacts on snow patterns and ski resorts, which were not the focus of this study which has an emphasis on cities. No analysis has been carried out to understand the potential impacts on ski resorts across the Highlands.

Figure 7 shows significant impacts associated with sea level rise, fluvial flooding and increased drought risk are expected to affect all sectors negatively, while positive impacts are likely to result for all sectors from a reduction in extreme cold spells.

Summary of projected impacts on sectors:

The most significant negative impacts are expected to be due to pluvial flooding and risk of drought, with these impacts affecting all sectors of the economy. A reduction in extreme cold spells is likely to have positive impacts across the economy. Increase in the length of the tourist and growing season is expected to have broadly positive impacts, particularly for business in the Distribution, Transport, Accommodation and Food sector, however, there will also be negatives.

Figure 7: Sector breakdown (% of Highland Council area Gross Value Added)



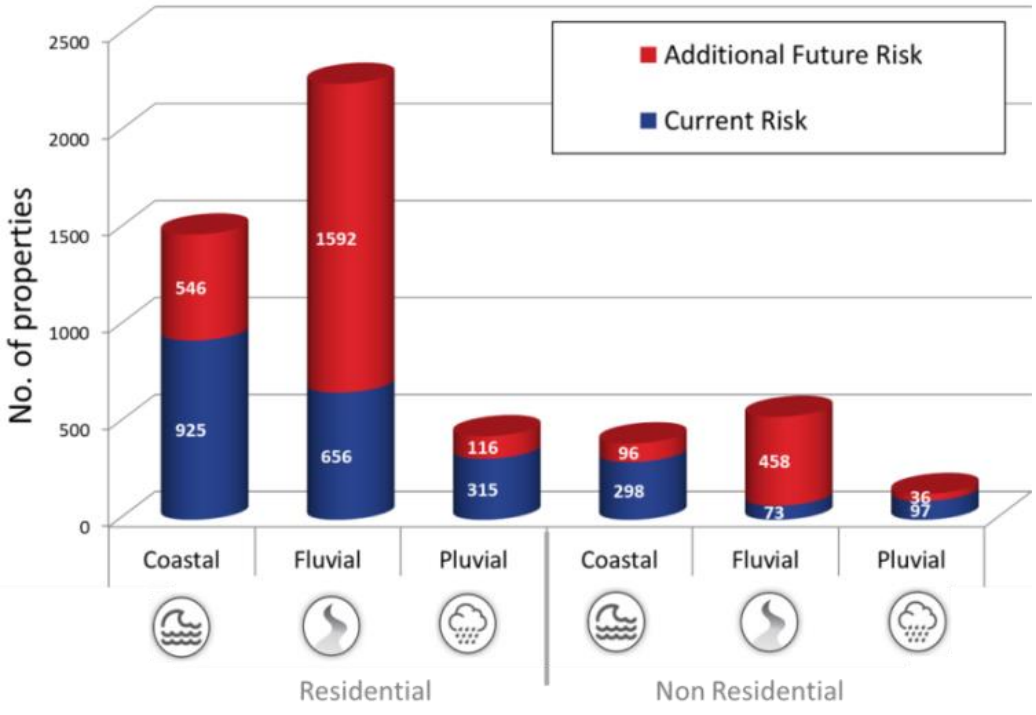
Source: Sector data taken from ONS, 2011

Impacts on Residential Properties

The major climate change impact predicted to affect domestic is flooding. The estimates show that the biggest risk to these properties in Inverness is likely to come from fluvial flooding mainly from the River Ness, followed by coastal flooding and then surface water (pluvial) flooding. The projections developed as part of this study show that by the 2050s, the number of residential properties at increased risk of flooding will be significantly higher, as the probability of an extreme event happening doubles. Figure 8 shows the number of properties expected to be at risk from flooding by the 2050s, with more detail provided in Appendix B.

The estimated value of the increased damage moving from a 1:100 to a 1:200 event on the lower reaches of the River Ness is about £1.2m[22] (in present value terms). The Mill Burn also poses significant risk to properties within Inverness. A recent report suggests that the banks will be breached in places by very low return period events; as low as 1:2 in places[23]. Aside from flooding, residential properties could also be significantly impacted by reductions in hydrological water availability to the city, limiting water supply.

Figure 8: Properties at risk of flooding in 1:100 events



Note: Quoted figures are based on interpolated estimates and do not imply a high level of accuracy. See Appendix B for detail on derivation methodology.
It is noted that the SEPA data used in this study does not allow for the protection provided by the River Ness Flood Alleviation scheme which is currently under construction. It is understood that SEPA plans to update the flood data once the Ness alleviation scheme is complete, which will offer protection to some of the properties shown to be at risk in this study.

Adaptation Actions

The climate change projections highlight a number of areas where adaptation actions will prove beneficial for Inverness. However, in order to focus the outputs of this study, only the key risk or opportunity areas are considered further here.

As noted above the water supply system in Inverness is vulnerable to drought. This risk for the Inverness Water Resources Zone has been recognised by Scottish Water through their water resource planning process.

Scottish Water is developing options to increase the resilience of Inverness' water supply system through the provision of connections to additional water supplies. A sum of £5.7m was identified for this purpose in Scottish Water's 2010-14 Business Plan. The details of the proposed actions are not currently available for review, however, it is known that restrictions in a city's water supply infrastructure can serve to limit is growth abilities, so actions to deliver the required adaptation measures should be a priority.

In support of driving demand for water down, the Highland Council could look to adopt high standards of water efficient fittings in new build properties of all types and support businesses to move to non-potable sources of water where appropriate. As there are significant energy requirements to treat potable water, much of which is washed down the drain[24], actions which could encourage better or more efficient use of potable water supplies would not only serve to reduce the potential risks associated with a reduction in water availability over time, but they would also deliver mitigation benefits in the form of reduced carbon emissions associate with water treatment. While the focus of this plan and the general process is to encourage communities to become more self-reliant and build resilience to the effects of climate change, it could be extended to include behavioural actions which would also provide resilience benefits.

Inverness also faces significant additional risks from flooding by the 2050s, as documented within the River Ness Flood Study. Large areas of Inverness including the city centre have been identified as a 'Potentially Vulnerable Area'[25] within the National Flood Risk Assessment. Adaptation will, therefore, be vitally important for the local population and economy. The River Ness Flood Alleviation project has a cost benefit ratio of 3.5. This shows that the benefits of action far outweigh the cost associated with those actions. The capital costs of the scheme are estimated to be around £24m. This level of spending could support around 430 jobs in the design, planning and construction of the projects. Invested over a period of 3 years as is the programme for the works, this equates to the provision of around 140 jobs per year with a further 200 jobs per year indirectly supported in the wider economy[26].

The Scottish Government has stated outcomes to underpin a sustainable approach to flood risk management. These include: reducing flood risk; using landscapes with space to store and slow down the progress of floods; providing integrated drainage to reduce burdens on sewer systems and reduce flood risk; and undertaking flood management actions which will be adaptable to future climate change.

In delivering this locally, it is clear that building flood alleviation schemes is not the only option available. Building in resilience, storage and runoff reduction measures into urban areas and industrial sites will also play an important part in reducing the potential future damage costs.

Consideration of available and suitable measures will form part of the Local Flood Management Plan to be developed under the requirements of the Flood Risk Management (Scotland) Act 2009. The selection of options to be taken forward into this plan should aim to address adaptation requirements resulting from the various flood risks identified.

While it is not appropriate to pre-empt the conclusions of this detailed assessment, it is clear that to address the challenges faced from flooding sources in Inverness, it will be necessary to consider a range of adaptation measures.

In the event that heatwaves become more frequent, specific heatwave management actions may need to be considered including the preparation of heatwave plans similar to those prepared for cities in England[27].

In terms of risk to major transport infrastructure serving Inverness, locations which may be particularly susceptible to risk of flooding or landslide (including bridges that may be susceptible to scour) or storm/wind damage or extreme high or low temperatures or other natural hazards that may be exacerbated by climate change should be identified and mitigation considered where this is practical. Major transport operators and infrastructure owners may already have implemented such reviews. Close liaison should take place between these organisations and the Highland Council if this is not already in place to integrate with emergency planning procedures.

The deployment of temporary defences can be considered for the protection of major roads from flooding at critical locations although this is generally limited to deployment lengths of several hundred metres or less, depths of flooding less than about 1m and flood durations of only a day or so. Critical locations and deployment procedures can be identified as part of the Flood Emergency Plan.

Following a review of the possible approaches to adaptation, and considering the strategies already outlined by the Highland Council for Inverness and the Highlands a number of strategies have been identified which merit further consideration by the city.

It should be noted that priority actions to address adaptation needs are not identified for Inverness as a result of the fact that on-going planning work will identify local requirements and solutions to existing adaptation requirements, specifically the need to improve the resilience of the water supply network.

Building resilience into design standards and planning requirements	• Consideration could be given to the development of Sustainable Building Standards in conjunction with the development planning process. • Specific requirements could include; resilience in the design in flood risk zones, raised floors or the use of materials which are more resistant to water damage, 'at source' storm water retention and/or infiltration, green roofs/walls and expansion of green infrastructure and promotion of property level protection (with Local Authorities support through grant schemes or surveys and installation). • Inclusion of grey and rainwater harvesting and requiring high standards of water efficient fittings in new build properties, especially those with domestic green space, could also serve to support efficiencies in water use and drive demand reductions. • City specific supplementary planning guidance and policies could be developed to ensure measures are put in place in higher risk areas. This could also include 'design for exceedance' where infrastructure and developments are designed to channel and direct surface flows.

Green Blue Infrastructure (GBI) and Sustainable Urban Drainage Systems (SuDS)	• GBI combine resilient and adaptive measures with protection of environmental assets and enhancement of amenity; therefore, generating multiple environmental, social and economic benefits: including water reuse, energy demand reduction and reduced carbon emissions; recreation and amenity benefits; and improvements in physical and mental wellbeing. Many are considered to be 'win-win' in terms of adaptation and mitigation. • Promotion of SuDS is a key component of Inverness's Adaptation Strategy. For maximum impact retro-fitting SuDS to existing developments and transport infrastructure is likely to be required. • Inverness could consider a programme of SuDS measures for the installation of water butts and permeable pavements (on replacement), which have high cost benefit ratio potential. This could serve also to support a drive to reduce the risk posed by drought. Roadside rain gardens where space permits can complement this. • The Environment Agency in England estimated that there is the potential for 90% of semi-detached and detached properties to install water butts, and for around 45% of terraced housing. Therefore, these measures could be applied to Highland Council housing stock. Rainwater butt storage will also improve drought resilience. • City wide initiative for GBI or SuDS retro-fitting would provide supply chain certainty, allowing investment and growth, supporting lower skilled job creation and providing opportunities for apprenticeship or warden schemes - delivering a range of benefits to the employers, the employee and ultimately the city.

There is a growing body of evidence to help quantify intangible benefits associated with SuDS. While the costs and benefits of sustainable drainage compared to traditional drainage are site specific, the following benefits of SuDS have been identified:[28]

- 10% saving on capital costs (based on tangible costs and benefits only), with early consideration improving savings potential;
- SuDS are cheaper than a traditional drainage system in all cases (Defra comparative study);
- Benefits of SuDS are multiple times higher than their costs if delivered through collaboration across stakeholders (cost-benefit analysis in Birmingham and Coventry); and
- There is maintenance savings associated with SuDS. Harder-to-monetise benefits such as reduction in diffuse pollution, additional recharge to aquifers, deferred investments in sewage treatment capacity, and amenity value are commonly excluded for cost benefit assessments[29].

Natural Flood Management	• An initial review of SEPA mapping data suggests that Inverness has limited areas, mainly along the Ness, which have high potential to act as floodplain storage. • The nature of the topography in and around Inverness does provide the opportunity to consider management of some of the surface water and stream flows before they enter urban areas by natural flood management measures. These could for example include forestation or biofuel crops within runoff or floodplain areas to slow the flow; natural measures to control flow from upland areas; and review of agricultural practices to reduce runoff and improve runoff quality. • It is known that the creation and management of these types of areas can provide wider environmental and social benefits in addition to supporting efforts to manage flooding locally. • Benefits include access to additional recreational areas, amenity improvements, mental and physical health benefits associated with use of these areas, along with ecological network benefits allowing greater species movement and more connected habitats.

Storm and high wind resilience review	• Whilst the degree to which the frequency and severity of storms and high winds will increase remains an uncertain area, it will be prudent to review the vulnerability of buildings and infrastructure to high winds. Businesses could also be encouraged to conduct such reviews. Emerging science and good practice guidance in this area should continue to be monitored. • Inverness could consider a detailed review of risks posed by climate change as part of the further development of its adaptation. • Building standards for wind loading should also be considered if emerging science and practice on any increase in wind-speeds suggests this is merited.

Decarbonising Inverness's Economy

Climate change mitigation requires reductions in greenhouse gas emissions from all types of economic activity globally. As noted, Scotland has ambitious renewable energy and carbon reduction targets. Highland Council also has its own targets, along with plans and policies to realise these targets.

This report does not attempt to cover the full breadth of climate change mitigation policy, or all the actions that Highland Council already has in progress or planned. Instead the report attempts to highlight some key areas for Inverness to focus on in line with SCA's economic objectives and the carbon reduction measures identified in RPP2 (as detailed in Table 2).

Table 2: Key sectors in RPP2 and relevant carbon reduction measures for Inverness

Sector	Relevant measures for cities
Energy	Local and community ownership of renewable energy
Homes and Communities	Address fuel poverty, domestic energy efficiency, retrofit of existing housing, building regulations for new homes, decarbonisation of heat sector
Business, Industry and Public	Energy and resource efficiency in public estate, buildings energy standards, decarbonisation of heat sector
Transport	Decarbonising vehicles, road network efficiencies, modal shift to walking, cycling and public transport, business engagement around sustainable transport
Waste and Resource Efficiency	Provision of waste management facilities including collection, recycling, energy from waste
Rural Land Use	Limited relevance for urban areas

What is Inverness Doing?

A range of measures to reduce carbon emissions in Inverness and across the Highland Council areas and set out in published reports including Highland Council's Carbon Management Plans and Carbon CLEVER draft programme plan. Measures and targets in these reports are for the whole Highland area, and are, therefore, not all applicable to Inverness.

The range of carbon reduction actions in Inverness can be divided into two categories:

- Those to reduce emissions from the city estate, services and functions, over which the local authority has control. For instance, this currently includes street lighting, energy efficiency measures within the Council estate and waste management; and
- Those associated with lowering emissions from the entire local authority area. These have the potential for more significant reductions; however, the local authority is typically limited to guiding and influencing others to achieve these gains. In Inverness this includes the provision of electric vehicle charging points, sustainable transport initiatives including cycle ways, and encouraging increased recycling rates in the community.

Building on This

Having assessed the RPP2 policies and proposals, reviewed the current low carbon activities in place in Inverness and considered SCA objectives, a shortlist of key mitigation actions has been identified. This list of actions was considered alongside the unique aspects of Inverness including the nature of the economy and its population, the key growth sectors and the aspirations of the city. A high level appraisal of indicative costs and benefits for the shortlisted actions was completed.

Shortlist of Actions

While all of the actions identified here have benefits to offer, contributing both to meeting local and national targets and supporting economic development, three opportunities have been highlighted as priority actions to be taken forward by the city in the short to medium term. These are:

1. Programme to replace all street lights with LEDs;
2. Major buildings energy efficiency programme; and
3. Transformational change in the provision of cycling infrastructure.

The detailed assessment of these prioritised actions is provided in Tables 4, 5 and 6. A discussion of the other actions the city could further develop is then provided.

Priority Recommended Actions

Table 4: Action 1 - Programme to replace street lights with LEDs	
	**Description** 13,800 street lights replaced with low energy LED lights. This assumes that 90% of the 15,300 in the city area are replaced, as there may be a small proportion for which replacement is not cost effective. It is noted that there are a total of over 51,300 across the Highland Council area and therefore there is the potential for greater savings. These have not been allowed for in this action which is city focussed in line with the scope for this study. The programme would be an opportunity to install "smart" management systems to allow remote dimming and monitoring of lights, further optimising energy use and maintenance costs. This represents an illustration of the scale of opportunity available to Inverness used to estimate costs and benefits.
	**Justification** Opportunity to reduce the council's energy costs, which are projected to increase significantly over the coming years. This action would also provide associated carbon reduction benefits, in line with Highland's targets. Currently street lighting is responsible for 13% of the council's emissions. The financial payback is well understood and access to capital for funding street lighting programmes recognises this, with £2m in funding announced by the Scottish Government in 2013. The relative lack of complexity compared to other mitigation actions suggests this should be a top priority, which could be programmed to provide ongoing employment opportunities to Inverness.
	**Capital expenditure** £6.9m. This is based on a capital cost of £500 per lighting column. The Green Investment Bank quote a cost of between £500- £1,500, however, LED costs have recently seen significant reductions, with Scottish Futures Trust (SFT) now seeing this reduce to around £290.. £500 was chosen as a conservative approach. A full inventory of the existing assets would be required to develop a detailed business case, and economies of scale will also influence the total cost. Net Present Value over 20 years is £1.9m.
	**Revenue saving** £620,000 per year. At current electricity price. Future energy price rises will increase this saving. Reduction in maintenance costs is highly variable depending on stock replaced. Estimates are included for energy, maintenance and reductions in Climate Reduction Commitment (CRC) costs. These equate to £45 per light per year.
	**Payback Period** 11 years. This is dependent upon the savings realised from maintenance. The Green Investment Bank estimate those payback periods for street lights schemes will range between 5

Table 4: Action 1 - Programme to replace street lights with LEDs	
	and 15 years. With recent cost reductions, SFT are now seeing payback periods as low as 3 years.
	**Emissions reduction** Potential: 2,000 tCO_2e/year Based on a saving of 145kg of carbon per year per streetlight. This is equivalent to a 30% reduction in emissions from street lighting. This saving is equivalent to 3% of the Highland Council's emissions.
	**Jobs** 123 direct and 174 indirect job years. Over a programmed installation of 5 years this is equivalent to 59 jobs over 5 years. Primarily assumed to be in the installation phase, however, jobs in maintenance could also be expected. Based on the employment multipliers for the civil engineering sector from the Scottish Input Output tables.
	**Supply chain** With a sufficiently large and coordinated programme there may be supply chain opportunities. These are further considered within the Stage 3 Report.
	**Training or skills development** With a supply chain developed in Scotland, opportunities will be created for training and development in installation and maintenance.
	**Other benefits** Reduced light pollution, improved visibility and reduced maintenance. Opportunity for smart controls with remote dimming and monitoring of lights. The improved visibility has consequential safety benefits, both for road safety and for perceived safety for pedestrians.
	**Potential funding** Guidance and support for such re-lamping projects can be provided from the Scottish Futures Trust. Funding sources include Salix, the Green Investment Bank and prudential borrowing.
	**Collaboration** There may be opportunities for a more strategic approach, collaborating with other authorities to achieve efficient procurement and standardisation of equipment, and result in overall cost savings. This would further support the development of a local or Scottish supply chain.

Table 5: Action 2 - Major buildings energy efficiency programme
Description Model project assuming an uptake covering 100,000m^2 of building space, which is just under half of the total estate owned, occupied or managed by the Highland Council within Inverness. Within wards 14, 15, 16 and 17, the gross internal area of Highland Council's estate is around 212,000m^2, which compares to 800,000m^2 for the whole local authority area. This action is initially for council owned buildings, but could include collaboration with other public sector partners to induce behaviour change and to retrofit energy efficiency measures.
Justification The existing stock of buildings provides an opportunity to show leadership to the private sector while reducing future energy cost liability. Significant carbon reductions are possible, which would go a long way to contributing towards the Highland Council's commitment to reduce its own emissions. The financial arguments for reducing energy expenditure are clear, given Highland Council's projected increase in energy bills to 2020. A retrofit programme with sufficient longevity could be expected to provide employment opportunities for local businesses.
Capital expenditure In the region of £7m. This is based on a per m^2 cost estimate of £70 per m^2 on average, although this will be highly variable across a range of different buildings and dependant the extent of the retrofit. This is estimated based on costs provided by cities in this study for the provision of energy efficiency schemes in their buildings and further includes the cost of staffing for between 5 and 10 years to support the programme. It has also been benchmarked against other energy efficiency retrofit data, which suggests retrofit costs over a portfolio of projects are likely to be in the range of £40-80 per m^2. Given the uncertainty with regard to what is required to retrofit these buildings, this estimate should be considered indicative only at this stage.
Revenue saving At a 40% savings rate the revenue savings could be around £0.54m per year in reduced energy bills and Carbon Reduction Commitment payments. The net present value over 20 years is calculated as £0.7mm. The revenue saving is based upon averaging energy use data provided by cities in this study, and has also been cross-checked against Chartered Institution of Building Services Engineers (CIBSE) energy usage benchmarks. The margin of revenue savings will further increase if energy prices rise as forecast.
Payback Period Across a sizeable programme an average payback period of around 13 years could be expected, although the payback on individual projects will be variable. London RE:FIT suggest typical payback periods of 5-7 years, however, a substantial programme could be expected to include more challenging retrofit projects with lower paybacks. The choice of funding mechanism will affect how the capital expenditure is recouped.

Table 5: Action 2 - Major buildings energy efficiency programme	
	**Emissions reduction** 2,540 tCO_2e per yr. This is also based on a saving of 40%. This could save around 4% of Highland Council's annual emissions of 58tCO_2e. The RPP2 estimates that retrofit schemes such as these can deliver 48% savings.
	**Jobs** Such a scheme has the potential to support around 315 job years (95 direct and 220 indirect), or around 63 jobs for a 5 year programme. This is based on employment multipliers for the 'repair and maintenance' industry subgroup on the Input Output Tables for Scotland.
	**Supply chain** A significant programme of retrofit activity would create opportunities for the construction industry supply chain in Scotland.
	**Training or skills development** A significant programme of retrofit across the public sector in Inverness and across the 7 cities would generate a pipeline of long term secure job opportunities, many of which would be suitable for training programmes targeted on young unemployed and supported by local colleges. The types of retrofit measures are commonly undertaken by specifically trained trades; such as plumbers, joiners and electricians.
	**Other benefits** Increased comfort in public buildings for both staff and visitors, through better temperature regulation. Advanced control and monitoring systems offer "Smart Cities" opportunities. Retro-fitting may provide adaptation and resilience benefits, enabling better temperature regulation in both summer and winter. Retrofitting of buildings is also an opportunity to consider resilience to other climatic threats.
	**Potential funding** There are 'spend to save' opportunities to fund this type of programme. It is expect that it will require a package of funding which could be accessed from Green Investment Bank, Prudential Borrowing, Scottish Government Capital Grants or Salix. Scottish Futures Trust can provide support in structuring projects to access funding.
	**Collaboration** Collaboration with the wider public sector in Inverness would improve programming, training and skills development opportunities. Collaboration with other Scottish cities could include sharing learning on funding and developing training programmes.

Table 6: Action 3 - Transformational change in the provision of cycling infrastructure

Description

Investment in a range of cycling infrastructure and behaviour change activity to increase the modal share of cycling journeys and build on the city's reputation as Scotland's Cycling City. Activities to include provision of:

- Cycling infrastructure, which may include that set out in the Active Travel Audit for Inverness[30];
- Consideration of a push bicycle hire scheme (in addition to the electric bike scheme already being introduced), in line with the schemes being introduced in Glasgow and Stirling and under consideration elsewhere; and
- Behaviour change and promotional behaviour in partnership with local organisations including schools and large employers.

Justification

The Scottish Government's Cycling Action Plan aims to increase the number traveling by bicycle from 1% to 10% by 2020. Increasing active travel is a commitment of the Single Outcome Agreement for Inverness. An important part of this is its stated ambition to transition to a carbon neutral city is making the city easier and more attractive for people to move around through sustainable and active transport[31].

Inverness is a compact city and there is therefore potential for a greater modal share of journeys to be made by cycling or walking. Given progress made to date, with a modal share of 6% of journeys compared to a Scottish average of 1.3%, this could be an area for Inverness to continue to lead on.

Capital expenditure

The Highland Council have agreed to develop a transformational cycling programme, with a predicted budget of £15m over a five year programme. It is assumed that £7.50 per person per year will be spent in Inverness, which is 50% higher than the £5 per person per year referenced in research by Aberdeen University[32], to recognise the transformational ambition in Inverness. This results in a capital expenditure of £2.5m in Inverness (equating to 16% of the £15m). For the purposes of the estimates in this table it is assumed that 90% of this will be spent on infrastructure.

Revenue saving and Payback Period

Revenue savings and payback period have not been calculated, as this is not a "spend to save" type action.

The following wider economic benefits are calculated in "Value for Money: An Economic Assessment of Investment in Walking and Cycling":

- The average benefit per additional cyclist is £590 per year
- One additional cyclist required to "break-even" on £10,000 investment
- Average Benefit Cost Ratio of 19:1.

Therefore for the £2.5m to "break even" an additional 250 cyclists would be required.

Table 6: Action 3 - Transformational change in the provision of cycling infrastructure	
	**Emissions reduction** A high level estimate suggests 40tCO_2/yr could be saved from commuting journeys alone, if the modal share of commuting journeys in Inverness increases from 6% to 10% as set out in the cycling action plan for Scotland. This is based on reducing peak hour traffic flows of 2000 vehicles by 4% assuming an average journey distance of 5km[33]. It is worth noting that the actual emissions reduction achieved will be based on actual uptake and avoided car journeys, which will include other journeys in addition to work commutes.
	**Jobs** £2.25m spend on cycle infrastructure could result in 44 direct job years and 35 indirect, translating to 16 jobs over a five year programme. This is based on employment multipliers for civil engineering from the Scottish Input Output tables. Indirect benefits to jobs associated with tourism and cycling retailers have not been calculated.
	**Supply chain** Growth in cycling in the city will serve to support local cycle shops and jobs associated with cycling attractions in and around the city.
	**Training or skills development** Targeted training programmes associated with bicycle maintenance could be implemented.
	**Other benefits** The benefits of modal shift to cycling include reductions in congestion, air quality improvements and health and wellbeing benefits. These may result in financial savings to NHS and productivity gains to employers from a healthier workforce. There is the possibility to integrate cycling infrastructure into green spaces that also provide adaptation services.
	**Potential funding** Cycle specific funding schemes such as the Community Links Programme administered by Sustrans Scotland. National and European funding available. Just under £2.7m of match funding has been brought into Highland for cycling infrastructure to date.
	**Collaboration** Collaboration would need to include cycling bodies. Collaboration with other Scottish Cities could include mutual learning.

Additional Mitigation Actions

In addition to the prioritised actions discussed above, Inverness is already making significant progress on a number of other fronts. These are detailed below along with some potential opportunities to increase their application.

Car Clubs and Electric Vehicles

- The introduction of a Car Club is currently under consideration.
- Transport Scotland research suggests every car club car results in 17 fewer private cars.
- One publically accessible EV charging point in Inverness, with another planned for this year.
- Highland Council has two hybrid electric pool cars, one of which is in Inverness.
- Electric hire bike scheme is being trialled.

Transport is a significant source of emissions for Highland, with around 27% of the area emissions coming from road transport. Within Inverness, which is a compact city, there is recognition of the need for modal shift away from private cars. Active travel initiatives are a priority, as discussed in Table 6.

A "national network of car clubs" was identified in research published by the Scottish Government in August 2009 as being one of the most cost-effective measures for reducing climate change emissions from the transport sector[34]. The Highland Council is investigating the possibility for a car club to be introduced in Inverness.

The aim of having a car club would be to reduce car ownership in Inverness. Vehicles used within car clubs are usually small and have very low associated carbon emissions. Vehicles owned within the highlands are usually older than the Scottish average with higher carbon emissions per mile[35].

Highland Council installed a publically accessible fast EV charging point at Cathedral car park and is installing a further rapid charger at Raigmore Hospital. These charging points were installed as part of Transport Scotland. Across Highland there are 4 existing charging points and 8 planned for installation during 2014/15 (See Appendix 2 Carbon CLEVER Transport). Increasing the number of EV charging points in Inverness and the surrounding area should encourage more people to purchase and use electric vehicles.

The council obtained two hybrid electric cars on long-term lease and charging points on long-term lease in 2011/12 assisted by funding from the Scottish Government. One car based at the council headquarters in Inverness will be used daily by staff seeking hire cars for business travel. The usage of the cars will be monitored with a view to extending to a fleet of hybrid pool cars in the future[36].

Highland Council is working with Co-wheels and Scottish and Southern Energy to operate an electric bike hire scheme which was launched in summer 2014, with 12 electric bicycles installed in the city centre. The bicycles are pedal assisted, have a conservative battery range of 30 miles. This should encourage people to travel using green transport and reduce car usage in the city. The scheme should also increase awareness of using more sustainable modes of transport in the city.

Domestic Energy Efficiency

- Fuel poverty affecting almost 1 in 3 households in Highland, with 12% in extreme fuel poverty.
- Fuel poverty exists where a householder has to pay more than 10% of disposable income on energy for the home.
- Highland council is spending £10m by 2015 on energy efficiency measures in council houses.

Fuel poverty is a significant issue in Inverness and across Highland. The Scottish House Condition Survey (2004-07) has found that almost 1 in 3 households in Highland are considered to be in fuel poverty and 12,000 households (12%) are in extreme fuel poverty[37]. This statistic includes rural properties across Highland without mains gas connections and therefore does not accurately represent the statistics for Inverness. Notwithstanding this, fuel poverty is a significant concern for the city.

The Highland Council will work with Home Energy Scotland to ensure everyone can access assistance. Home Energy Scotland provides free advice on energy efficiency and helps people in fuel poverty access grants from the Scottish Government and energy supply companies.

The Highland Council are spending £10m on energy efficiency measures in council houses as part of its target to achieve the Scottish Housing Quality Standard by 2015[38]. The Council plan to improve energy efficiency by insulating and heating all Council housing to a good standard (NHER 5) as part of their capital programmes. This will include using renewable technology in heating systems in 200 Council houses each year[39]. The Council will also help to insulate private owners and landlords' properties. For new housing developments sustainable and renewable technologies are being encouraged through the planning process.

Further support to the private domestic housing sector could be to promote the uptake of the Green Deal to a broader range of tenants and homeowners, which could deliver additional benefits both in terms of energy and emissions reductions and in terms of the creation of a demand for a skilled workforce to deliver the measures; creating both employment and training opportunities for the local population. The Green Deal is available to make energy-saving improvements and typically covers the following measures:

- insulation;
- heating;
- draught-proofing;
- double glazing; and
- renewable energy generation (e.g. solar panels or heat pumps

However, it is acknowledged that to date, uptake of the Green Deal has not been as high as expected, with the scheme criticised for being overly complex and not offering sufficient incentive.

District Heating

- Highlands and Islands Enterprise have undertaken a District Heating feasibility study at Inverness College Campus.
- Heat Mapping undertaken for Highland in 2011, prior to the national mapping becoming available.
- Residential district heating schemes can alleviate fuel poverty where housing density is sufficiently high.

Decarbonising the heat sector, diversifying heating fuel sources and addressing fuel poverty are Scottish Government objectives as set out in the Draft Heat Generation Policy Statement. It is estimated that heat is responsible for 47% of total Scottish emissions.

A feasibility study conducted for a district heating scheme for Inverness College Campus which would serve a mixture of property types (34,00m^2 non-residential, 300m^2 business, 10,000m^2 residential and 8,000m^2 assembly and leisure) using biomass fuel. This also explored options to connect to Raigmore Hospital.

Box 3: Heat Mapping

Heat mapping uses complex data sets to create a simple tool to help identify opportunities for linking local heat supply with local heat demand. Using GIS, it provides a visual representation of the different levels and locations of demand and supply within a specific area. This allows stakeholders to make local connections, supporting the move towards a heat network that functions more efficiently in terms of cost, security and carbon emissions. Heat mapping can also be used in conjunction with other data to identify focal points for targeted activity or to illustrate the additional socio-economic benefits from a changing heat network.

Using data supplied by both the public and private sector, and building on previous work undertaken in Highland, Perth and Kinross, and Fife, the Scottish Government has developed a national heat map for Scotland. Scotland's Heat map database is available to all local authorities in Scotland as file-based geodatabases which can be easily imported and used by local authority officers to help in policy and decision making processes. A guide to using the tool for local government is available[40].

In addition, a higher level or 'lite' version of Scotland's Heat Map is also publically available as an on-line tool[41]. The Scottish Government has committed resources to refreshing the heat map in 2015-16.

Making it Work

The current Scottish Government proposals and policies for transitioning Scotland to a low carbon economy and becoming a more resilient country are extensive. They provide a significant policy landscape against which Highland Council, and for the purposes of this Cities Alliance Report, Inverness can play its part in that journey.

The Scottish Government's RPP2 sets out a variety of routes by which Inverness can implement actions in accordance with the broader decarbonisation agenda. So how is Inverness responding to that agenda?

Observations made through research and engagement with the Highland Council and its stakeholders would indicate that Highland Council is a local authority which is currently operating a wide range of sustainability focussed initiatives. The Carbon CLEVER initiative works well as organising coordinating mechanism for the activity the council is taking and it also creates a very strong brand which the council is benefitting from in terms of its image and stakeholder and staff engagement. The council also benefits from strong and informed elected member engagement on climate change. Additionally the council is good at aligning carbon savings with cost savings. Climate change adaptation and mitigation responsibilities sit within the remit of the Resources Committee. This sends a clear message around the financial aspects of pursuing a low carbon economy and is commended.

In terms of its own activities the council has undertaken a broad range of activities in the areas of estate asset management, waste management and green travel which supports the key sustainability aspects of the Community Planning Partnership Single Outcome Agreement (SOA). The SOA has a strong appreciation of the benefit of the low carbon economy as a key driver for growth in the area and accordingly it recognises the key economic growth sectors in the area, as energy and renewables, tourism, food and drink, life sciences, the university sector plus creative, financial and business services, which can be outsourced. The council was also one of the first in Scotland to develop a strategic approach to climate change adaptation when it published in 2012 the Adapting to Climate Change in Highland strategy.

Where Inverness differentiates itself from other cities within the Cities Alliance is in its creation of the Carbon CLEVER Initiative. It provides a strong focus for the council's own activities and creates an umbrella under which other stakeholders can contribute. Importantly is sets an ambition of making Inverness carbon neutral and the Highlands low carbon by 2025, this is an ambitious target and shows strong leadership. With its five key strategic themes of the Economy, Energy, Land Use and Resources, Transport, and Engagement, the initiative has both breadth and firm focus on where progress can be achieved. It is proposed that each of these themes will have its own strategy and the full action plan for delivery will be launched in November 2014.

In respect of the activity that is the focus for the economic aspect of Carbon CLEVER, this includes recognition of the importance of attracting increased inward investment into the area which will deliver high quality employment opportunities. There is also a strong recognition of the role of EU funding to support elements of the programme and the area has a strong track record in attracting EU finance.

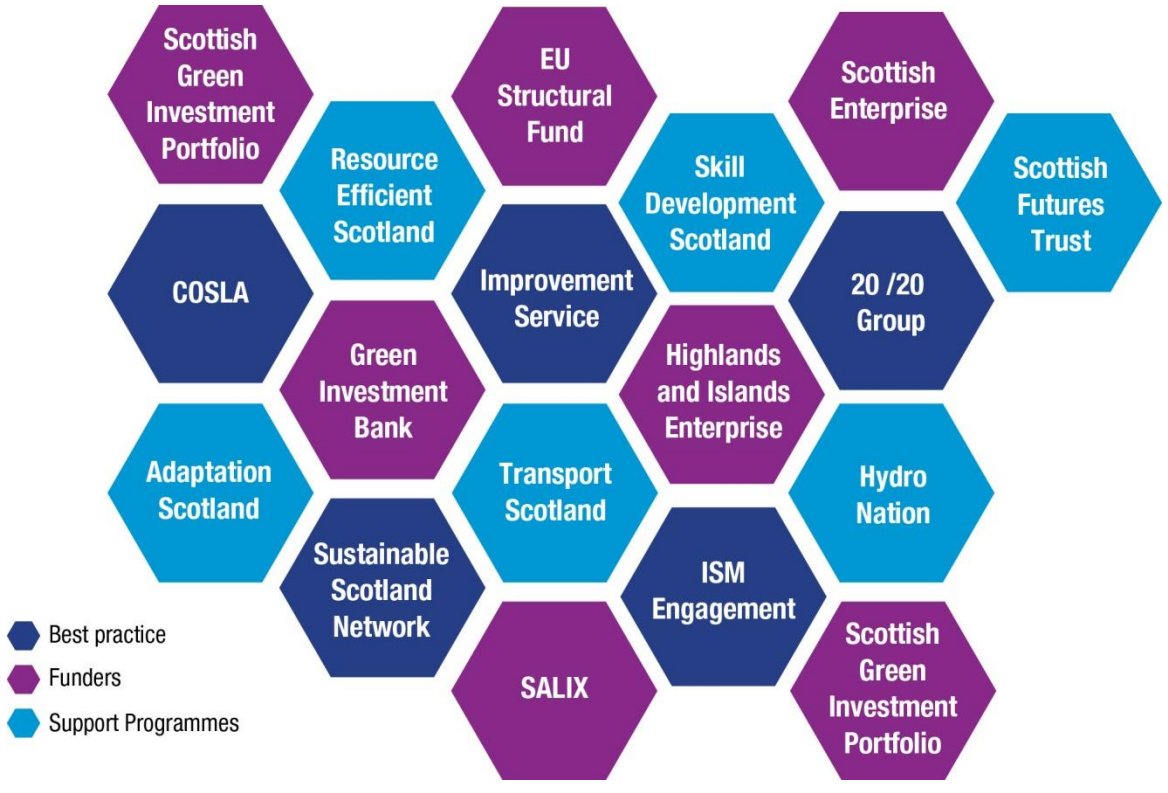
Available Support

One of the recurring themes from the city engagement process was a general lack of capacity to support the delivery of the low carbon and adaptation agenda in the cities. Within Scotland there is a significant stakeholder landscape around delivering the Government's ambitions on tackling and adapting to climate change and achieving sustainable economic growth. That landscape consists of a wide range of both public and private sector stakeholders who constitute a significant resource to support low carbon and adaptation activity across a range of city services and responsibilities. Some of these available resources are outlined below for information.

In addition to these sources of financial support there is a further range of funding opportunities for specific initiatives from, current and emerging European funds, the Green Investment Bank and the Scottish Green Investment Portfolio as well as the prudential borrowing scheme. There are also mechanisms such as Energy Service Companies (ESCO) which can be set up to finance particular schemes such as district heating or other energy generating projects.

Details of the ISM model also provided in Box 4, this provides a framework and support to maximise sustainability outcomes.

Figure 9: Available support landscape



BOX 4: ISM – Individual, Social and Material

ISM is an analytical framework developed as part of the Scottish Government's Climate Change Behaviours Research Programme (2010-2013). It promotes a more holistic approach to the design and evaluation of behaviour change interventions.

ISM is based on theory and evidence which shows that three different contexts – the Individual, Social, Material – influence behaviours. In order to achieve enduring and substantive change, interventions should take account of influences across the multiple contexts of I, S and M.

The Individual context includes factors such as attitudes, habits and skills. Factors such as social norms, meanings and opinion leaders are considered as part of the Social context. Material factors are concerned with constraints and boundaries. These range from infrastructure and technologies to rules and regulations, time and schedules etc.

Following its launch in 2013 a range of public sector bodies and other agencies have trialled ISM including some local authorities. Amongst these, Highland Council is creating internal capacity in using ISM to help develop and refine their Carbon Clever programme. The Sustainable Scotland Network is currently funded by Scottish Government to promote and support understanding and use of ISM within the public sector.

Collaboration

A key element of the overall project is to explore the potential for collaborative projects across the SCA, assessing the opportunities for the cities to participate in low carbon projects that maximise the economic as well as environmental and social benefits. Fewer opportunities exist for collaboration across adaptation projects, however, retrofitting projects could provide procurement and supply chain related benefits if collaborated on.

Complementing the individual city reports (this report) is a separate report that presents the collaborative potential and the value of investment in the recommended low carbon and adaptation measures to the Scottish economy. This involves an Input Output analysis[42] to track how spending could be expected to travel through the Scottish economy and generate growth and employment with a particular focus on the cities.

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