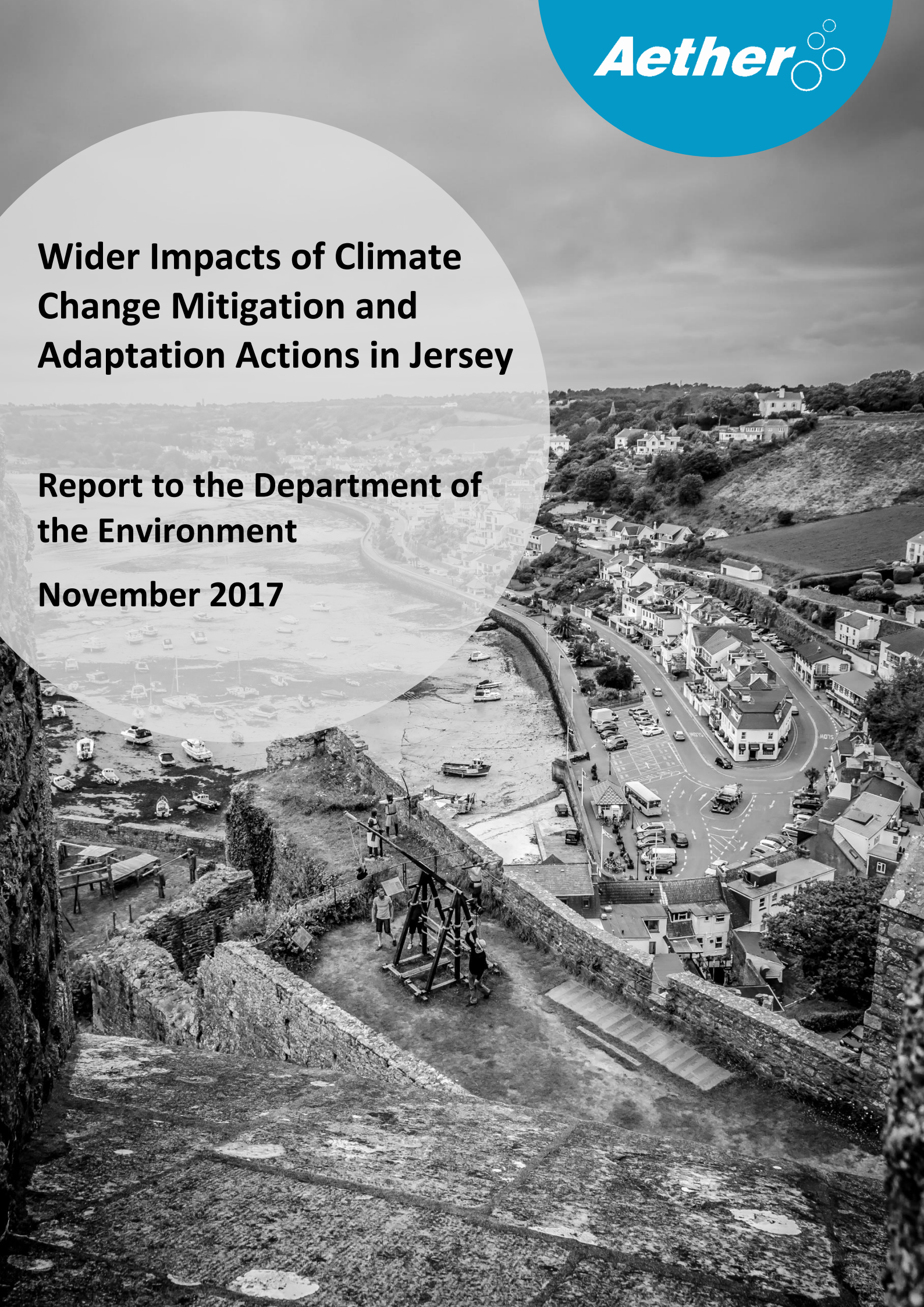
Wider Impacts of Climate Change Mitigation and Adaptation Actions in Jersey

Report to the Department of the Environment

November 2017



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Executive Summary

Introduction

Jersey aims to reduce emissions of greenhouse gases in 2050 by 80% compared to 1990 levels (States of Jersey, 2014a). To achieve this goal and to minimise the impacts of climate change, Jersey has set out mitigation and adaptation actions. In addition to these actions addressing climate change, they can also have wider impacts on other sectors such as health and the economy, and these impacts can be positive and negative. Analysis of these wider impacts to identify potential synergies and conflicts will lead to more joined up and effective policy making.

This report, commissioned by the States of Jersey Department of the Environment and written by Aether, examines the wider impacts of Jersey climate change actions in the context of the Future Jersey outcomes. Future Jersey is the basis for the long-term, shared vision for Jersey and includes community, environmental and economic outcomes. These outcomes were identified through public consultation to explore what people felt were priorities for Jersey in the future.

An overview of wider impacts

Following a review of key documents and relevant literature alongside stakeholder engagement, the climate change mitigation and adaptation actions currently being implemented in Jersey were collated into eight groups. An overview of the key wider impacts associated with each of these eight actions is provided below.

Active travel can provide significant health benefits through increased physical activity and decreased air pollution (when active travel replaces private car travel). The lowered disease burden has associated economic benefits through a reduction in health care costs and an increase in the size of the workforce as more working-age people could be in good health. If private car travel is replaced there are also energy security benefits from a decreased reliance on imported fossil fuels and affordable living benefits as the cost of travel is cheaper. Careful planning and infrastructure investment will be needed, however, to avoid a potential increase in road traffic accidents as more people walk and cycle.

Public transport and infrastructure improvements can offer health and wellbeing benefits. For example, through improved access to social networks and services such as health care (especially for vulnerable groups such as the elderly) and a potential increase in physical activity (if travel to public transport is by walking or cycling). It can also improve access to employment opportunities for vulnerable or low-income groups who could previously not afford to access these opportunities. There are also benefits for people travelling around Jersey through reduced congestion as the volume of traffic is lower, especially during peak hours. If modal shift occurs it important to lock in this benefit for example through road space reallocation.

Alternatively fuelled vehicles could provide health and wellbeing benefits through reduced air pollution and reduced noise. This could improve quality of life and potentially increase house prices for residents that live near roads. The most significant potential wider benefits, however, come from an increased energy security due to a reduced demand for imported fossil fuels. This benefit is maximised when electricity is sourced from renewable sources. A potential conflict may arise though if the decrease in

demand for imported fuel leads to loss of income and jobs in sectors that rely on trade of fossil fuels.

Energy efficiency improvements in residential, public and private buildings can have significant health and wellbeing, energy security and affordable living benefits. Benefits are especially felt by those who are living in fuel poverty and include; reduced energy bills, reduced fuel poverty and access of to a decent standard of living for a greater number of people. The health benefits are especially important as there is a reduced exposure to cold living environments and increased income that can be spent on other commodities such as food. There are also mental health benefits as living conditions and general quality of life improve. With a decreased reliance on imported energy, Jersey is less vulnerable to disruptions in supply.

The most significant benefits of renewable energy in the domestic sector relate to increased energy security. A decreased reliance on imported energy reduces Jersey's vulnerability to shocks in price and loss of supply. This can also be translated into economic benefits through reduced energy bills as households can generate their own energy. However, some renewable energy installations can be considered as visually intrusive, a conflict that must be carefully managed.

Sustainable agriculture measures allow for the intensification of farming practices whilst also protecting the environment and natural resources. Reduced nitrogen run off is a key outcome and has benefits for water quality, biodiversity and human health. Sustainable agriculture practices could also provide farmers with economic benefits, for example reduced expenditure of fertiliser and increased efficiency.

Adapting to sea level rise and extreme weather events will be essential for Jersey due to the impacts of climate change. Protection against extreme weather events has safety, health and economic benefits. By adapting to extreme weather, the resilience of essential service and infrastructure, property and natural assets is increased. Beyond the clear economic benefits of reductions in damage costs and forced migration, this also has mental health benefits as people are less concerned about the potential impacts of increased extreme weather events. This is particularly applicable to St Helier which is low lying and coastal but is also home to a large proportion of Jersey's population, business and heritage sites.

Many of the benefits outlined above can also be achieved and facilitated through behaviour change and improved communications. Behaviour change, education and demand reduction are all closely linked and should complement any technical measures. For an individual, the benefits of behaviour change can be low cost and immediate, for example lower energy bills. Communicating the multiple benefits of behaviour change is vital for these policies to be effective.

An overview of barriers

There is clearly potential for significant wider impacts to be gained as a result of actions targeting climate change mitigation and adaptation. However, there are barriers that either prohibit the implementation of these actions or minimise the wider benefits that can be gained. These include:

Translating governmental targets into clear and consistent messages. There is a need for clear, consistent messages that translate Jersey's targets into local actions. This needs to be accompanied by comprehensive and consistent performance monitoring across

policies and sectors. This barrier can be overcome through regular and effective communication across levels of government and relevant stakeholders. This should include easy to understand evaluations of policy impacts to increase public engagement and identify the most effective policies.

Political will and funding for implementation of climate change action. A four-year political cycle in which Government is expected to provide quick and proven results can mean there is a lack of political appetite for climate change actions. Climate change actions are often hard to measure and the threat can seem more distant than, for example more immediate health emergencies. This, combined with a fear of the unknown and cost of exploring options can lead to a lack of long-term thinking and inaction. This barrier can be overcome through awareness raising among the public and increased engagement between policy-makers and stakeholders. An assessment of wider impacts is one way to achieve this as it highlights potential synergies between environmental, economic and social goals, leading to joined-up, efficient policy making. It also allows for the identification of specific hooks that could make climate actions more publicly and politically acceptable.

Public understanding, beliefs and behaviours. Climate change is a complex, global issue that can be hard to understand. Individuals can struggle to comprehend the impact that they can have and are reluctant to change their beliefs which are rooted in experiences, knowledge and tradition. This barrier can be overcome through social science research into beliefs and an appreciation of the individual hooks to facilitate change. For some, the health of their children is a priority whilst for others this may be house prices or noise reduction. Therefore, an appreciation of wider impacts can help to encourage a willingness to change among the public.

A consideration of wider impacts, synergies and conflicts, is essential for efficient, joined-up policy making. To maximise efficiency, however, there needs to be a recognition of the barriers that are specific to Jersey as these impact the magnitude of wider impacts that can be experienced. These barriers require targeted action to be overcome. A consideration of climate change and climate actions needs to be embedded into wider governmental strategies as a way of bringing together community, environmental and economic goals.

List of Acronyms

ASC - Adaptation Sub-Committee

CO - Carbon monoxide

CO_2 - Carbon dioxide

ICZM - Integrated Coastal Zone Management

IEA - International Energy Agency

GDP - Gross Domestic Product

GHG - Greenhouse gas

GVA - Gross Value Added

NO_x - Nitrogen oxides

PM - Particulate Matter

UK - United Kingdom

ULEV - Ultra Low Emission Vehicle

WHO - World Health Organisation

Contents

1 Introduction

Jersey aims to reduce emissions of greenhouse gases in 2050 by 80% compared to 1990 levels (States of Jersey, 2014a). To achieve this goal, Jersey has laid out mitigation actions to reduce and avoid emissions. It has also laid out adaptation actions which consider the impacts of climate change. These actions directly concern climate change. However, they can also have impacts on other areas, such as health and the economy. These impacts can be beneficial (positive) or detrimental (negative). It is therefore important to analyse these wider impacts to identify potential synergies and conflicts, leading to more joined up and effective policy making. Aether was commissioned by the States of Jersey Department of the Environment to carry out an investigation into the wider impacts of Jersey's climate change mitigation and adaptation actions. The outcomes of this study are presented in this report.

1.1 Project Aims and Objectives

The strategies of Jersey focus on the improvement and sustainability of the economy, infrastructure and development, quality of life for its citizens and the wider environment. The majority of investment, resources and implementation decision making is therefore focussed in these key areas. Any action on climate issues need to be integrated into these wider concerns and activities/actions. Climate policy needs to influence these much broader priorities and ensure action in these areas are sensitive to and achieve climate commitments on adaptation and mitigation.

This report aims to increase the understanding within the States of Jersey of the potential wider impacts for Jersey of climate mitigation and adaptation actions. This will support the States of Jersey in efficient policy making and the further development of accelerated climate actions that work in harmony with wider governmental strategies and goals.

The objectives of this report are:

- To produce a synthesis of the qualitative evidence of possible wider impacts of Jersey climate actions, including the direction (positive or negative) and the magnitude of the impact.
- To include, where possible, quantitative assessment of the potential wider impacts of climate actions.
- To present the findings within the Jersey context, relating wider impacts to the Future Jersey outcomes and indicators.

These objectives are underpinned by the following research questions:

1. What is the qualitative and quantitative evidence for the wider impacts of climate actions within the Jersey context?
2. What are the directions and possible magnitudes of the wider impacts of climate action in Jersey?
3. What are the most significant gaps in research and evidence relating to the wider impacts of climate action in Jersey?

Questions 1 and 2 are addressed in the Wider Impacts sections (Sections 3 to 11). Each section contains a matrix that gives an overview of the magnitude and direction of wider impacts relating to the Future Jersey indicators for each group of climate actions. Question 3 is addressed in the Research and Knowledge Gaps section (Section 12).

1.2 Definition of wider Impacts

To address the increasing threat from climate change, mitigation and adaptation actions have been implemented. For example, in the transport sector policies have been implemented to encourage the uptake of electric vehicles and the use of active travel (walking and cycling). In the built environment sector, measures to increase energy efficiency in public and private buildings have been introduced. There is a wide and increasing recognition that action to mitigate and adapt to climate change can have wider impacts socially, economically and environmentally (Committee on Climate Change, 2017). These impacts can be positive and negative. For example, improved insulation as a measure to tackle energy efficiency can have impacts including:

- Reduced fuel consumption
- Economic impacts e.g. reduced fuel bills
- Energy security impacts e.g. reduced reliance on imported fuels
- Health impacts e.g. reduced mortality from cold living environments.

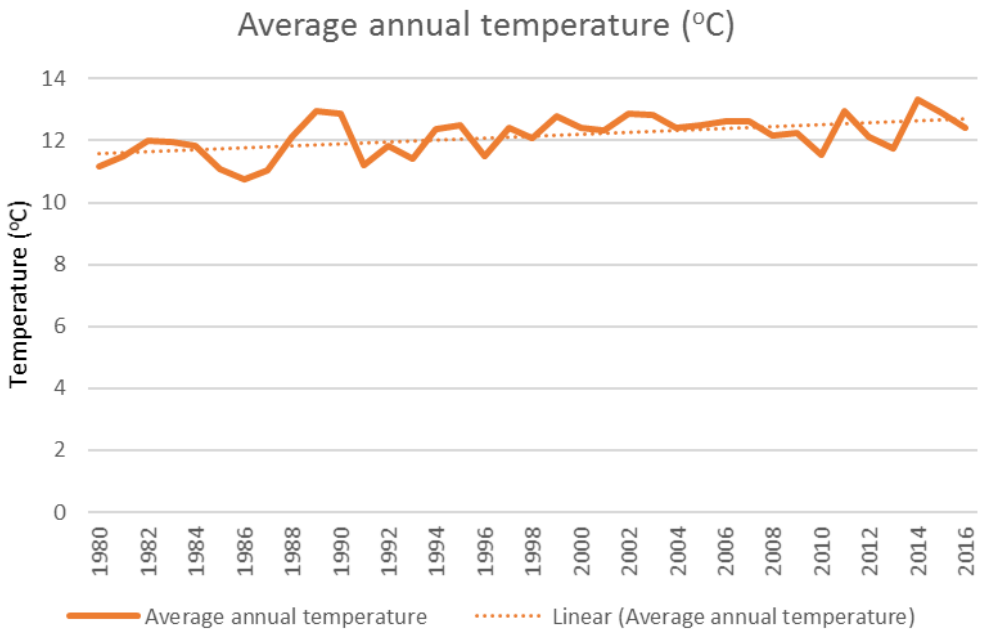
A consideration of wider impacts therefore paves the way for a more joined up approach to policy making. It can highlight which policies will lead to maximum benefits and can also show where caution should be taken.

2 Jersey's Vulnerabilities, Risks and Strategic Planning

2.1 Vulnerabilities and pressures

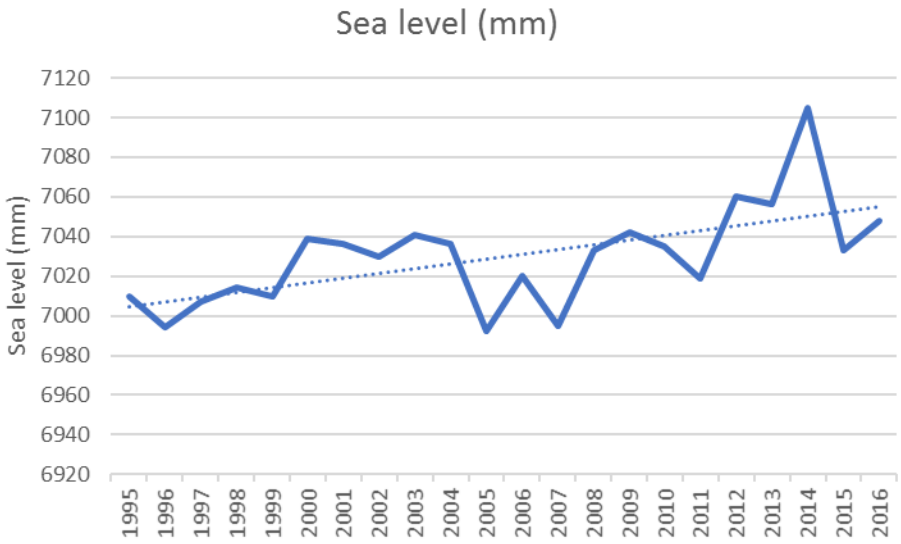
Islands are particularly vulnerable to the impacts of climate change, largely due to the risk of high tides and storm surges. With sea levels rising and the frequency of storm surges increasing, there is a need for islands to mitigate against, and adapt to climate change (Ellis & Smith, 2015). This change can be seen in weather patterns in Jersey. The period from 2011 to 2015 shows a longer growing period (crops) and increased summer and winter rainfall compared to the 30-year norm (1961 to 1990) whilst the period 2005 to 2015 shows fewer cold spells, more warm spells and an increased sea temperature compared to the 30-year norm (Department of the Environment, 2016). **Figure 1** illustrates the steady increase in average annual temperature experienced in Jersey from 1990 to 2015. The UK Committee on Climate Change predicts that the Channel Islands could experience a mean winter temperature rise of up to 3.1°C and a mean summer temperature rise of up to 4.2°C between 2040 and 2069, relative to the period 1961 to 1990. It also predicts that over this period, average annual winter precipitation could increase by between 0.2 and 30.4% while average summer precipitation could change between +0.9 and -40.8% (ASC, 2016).

Figure 1 - Average annual temperature for Jersey. Data supplied by the States of Jersey Meteorological Department, 2017.



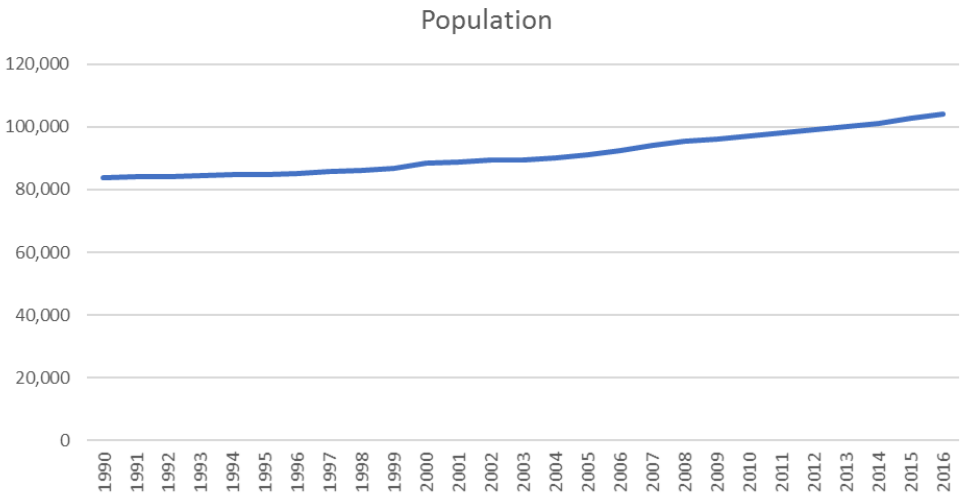
Furthermore, Jersey is also under threat from sea level rise, as shown by Figure 2. Since 1960, the sea level in Jersey has risen by an average of 2 millimetres per year. However, projections to 2100 suggest that the level could increase to 3mm per year. This could, under an average emissions scenario, equate to a sea level rise of 0.48 metres by 2100. This would result in the sea rising over the top of sea defences more frequently and with greater severity (Prime, 2017).

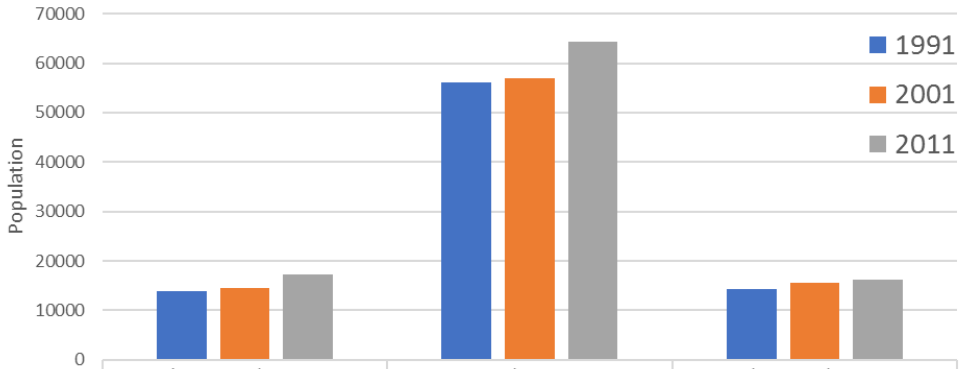
Figure 2 - Annual sea level rise for Jersey. Data obtained from the Permanent Service for Mean Sea Level, 2017.



The potential impacts of climate change can be exacerbated with a vulnerable population; elderly, children, those living with illness or disabilities. Jersey has an ageing population, with an increasing proportion of the population being above working age (**Figure 3**). This causes an increase in dependency ratio; the number of non-working age people to the number of working age people (World Bank, 2017).

Figure 3 - Population of Jersey from 1990 to 2016 including a breakdown of population by age group obtained from census data.





	Above working age	Working age	Below working age
1991	13851	56005	14226
2001	14507	57015	15664
2011	17291	64353	16213

2.2 Jersey Strategies

Policies and goals relating to climate change exist within Jersey. These differ in time scale and nature and address both climate change mitigation and adaptation as well as a longer-term vision for the island.

Island Plan 2011

The Island Plan sets out a framework for the development of Jersey and is reviewed every ten years. It sets out plans to 2020 and considers other planning policies such as the States of Jersey's Strategic Plan 2009-2014. Priorities for the Strategic Plan that feed into the Island Plan include: maintaining a strong, environmentally sustainable and diverse economy; maintaining and developing infrastructure; protecting the natural and built environment; providing adequate housing; and protecting Jersey culture and identity (States of Jersey, 2011). Part of the Island Plan is the Strategic Policy Framework which defines how land is used for the period of the Plan. The following are underlying principles of this framework:

- Sustainable development – where a development should be located, how it will be assessed, how land and buildings should be used and how energy use can be made efficient and carbon neutral
- Protect the environment – how to protect Jersey's identity which is expressed through nature and quality of both natural and historic environment
- Economic growth and diversification – how land and development opportunities will be protected, maintained and enhanced to support the growth of the economy
- Travel and transport – how planning will reduce the need to travel and the dependence on private cars through the provision of choice
- Quality design – how proposals for development will be tested using urban design principles to ensure high quality.

Future Jersey

Through public consultation, the States of Jersey aims to set out a shared, long-term vision for the Island. Future Jersey is the final phase of this discussion. Long-term community, environmental and economic ambitions were proposed and participants were asked to provide comments on these and the vision more generally. The vision includes:

- 3 themes - community, environment and economy
- 10 outcomes - the desired results
- 58 indicators - for assessing progress towards outcomes
- An ambition level for each indicator - continue, improve or transform the trend (States of Jersey, 2017b).

Future Jersey provided an effective framework for this report, the wider impacts of climate change actions being related to the outcomes set out in Future Jersey. The report will highlight possible synergies and conflicts with the Future Jersey outcomes.

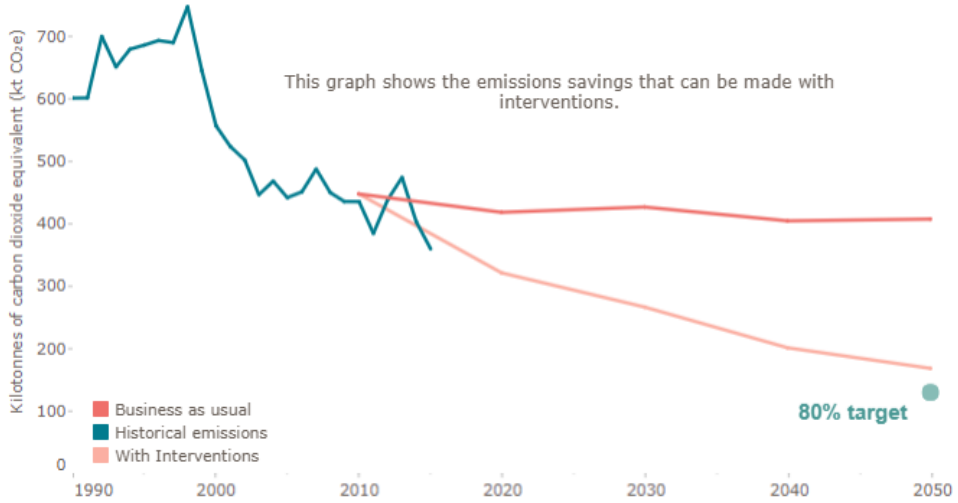
Climate change mitigation

The climate change mitigation targets for Jersey are set out in 'Pathway 2050: An Energy Plan for Jersey', published in 2014. This document outlines the challenges facing Jersey in a changing climate and the policy responses. Jersey aims to reduce emissions in 2050 by 80% compared with 1990 levels and will achieve this by using secure, affordable and sustainable energy (**Figure 4**). This contribution to the reduction of carbon emissions is in line with comparable countries. The plan is underpinned by three core principles:

4. Sustainability – the focus being on reducing demand
5. Addressing fuel poverty and affordability of energy
6. Ensuring security of supply

For each of these principles, specific actions are outlined and these form the mitigation actions of Jersey (States of Jersey, 2014a). The specific actions will be detailed in the following sections of this report.

Figure 4 - Graph of emissions savings that can be achieved through implementation of the Pathway 2050 actions. Source: Jersey infographic, 2017 which can be accessed here https://www.gov.je/Environment/GenerateEnergy/Pages/GreenhouseGasEmissions.aspx



Adaptation to climate change

While Jersey currently does not have a formally adopted adaptation plan, the Jersey climate resilience and adaptation work stream commenced in December 2014. In June 2015, the Council of Ministers demonstrated their commitment to taking forward a climate change adaptation work stream. It was recognised that climate change is a States of Jersey priority and there is a need to take a proactive approach to integrating resilience and risk into all aspects of Jersey policy (States of Jersey, 2015b). The States of Jersey's priority for 2016 to 2020 is to produce a Climate Adaptation Plan, including costings, which includes:

- An agreement on the baseline evidence for developing a resilience factor for Jersey
- A risk assessment – to identify strategic planning priorities
- An economic assessment of the investment needed in climate resilience compared to the risk of climate change impacts
- A climate resilience and adaptation framework that includes all relevant stakeholders
- A commitment to continue monitoring local weather, atmospheric trends and UK based climate models. The government is to work with experts to ensure the reporting of accurate sea level rise data.

2.3 Climate Change Risks

The UK Climate Change Risk Assessment 2017 identifies six risks that are a priority for the UK. These are detailed in **Table 1** below which gives a brief description of the risk, how the risk relates to Jersey and how urgent the risk is.

Table 1- An overview of the climate change risks for the UK and Jersey, adapted from ASC (2016).

Risk No.	UK Climate Risk Assessment Risk	Explanation of risk	Risk to Jersey	Priority status
1	Flooding and coastal change risks to communities, businesses and infrastructure.	Will impact: property values, business revenues and viability of communities. Risk to communities linked to resilience of local energy, transport and communications infrastructure. Local impacts are very variable.	Being an Island, Jersey is at risk from sea level rise. It is also at risk from pluvial (related to rainfall) flooding due to increased storm severity. The greatest risk comes from combined pluvial and coastal flooding.	Already high risk and expected to increase.
2	Risks to health, well-being and productivity from high temperatures.	Number of premature deaths from heat could triple by 2050.	A growing, ageing population means more people are at risk, due to, for example, increased heat stress.	Already high risk and expected to increase.
3	Risk of shortages in the public water supply, and for agriculture, energy generation and industry.	Reduced amount of water available for withdrawal and increase demand for irrigation. Growing population means added demand.	Jersey's population is growing therefore demand and potential risks are increasing. Drought and contamination of fresh water supplies by seawater are risks to Jersey.	Medium risk now but high risk in the future.
4	Risks to natural capital, including terrestrial, coastal, marine and freshwater ecosystems, soils and biodiversity.	Risks to wildlife and vital natural goods such as food, clean water, carbon storage and cultural benefits from the landscape.	Risk to natural capital in Jersey is high now. The natural environment is a key part of the Jersey identity and marine ecosystem are especially at risk from sea level rise. Habitats and biodiversity are also at risk from flooding, soil erosion and temperature impacts on biodiversity.	Medium risk now but high risk in the future.
5	Risks to domestic and international food production and trade.	Extreme weather events affecting international production, trade and supply could make food prices volatile. Longer term incremental changes in climate will likely alter agricultural productivity.	The large proportion of Jersey's food is imported from or through the UK (about 90% (Jersey Emergency Planning, 2012)). Extreme weather events, fuel shortages and other logistic difficulties within the UK will threaten food security in Jersey. Jersey is also an exporter of agricultural goods and these could be threatened by climate change (States of Jersey, 2012).	Medium risk now but high risk in the future.
6	New and emerging pests and diseases, and invasive non-native species affecting people, plants and animals.	Warmer and wetter conditions may allow some pests and diseases to extend their range. Disease outbreaks are hard to predict and have widespread direct and indirect impacts on communities and economies.	The outbreak of disease could have severe impacts on agricultural production where there is a reliance on single crops (States of Jersey, 2012). There are also potential human health risks in the future from invasive species such as the malaria mosquito.	Medium risk now but high risk in the future. More research is needed into how outbreaks can be contained.

Table 2 on the following page shows the impact that these six priority risks, identified by the UK Climate Change Risk Assessment, could have on Future Jersey outcomes. The most significant climate risk to Jersey is from storms and gales which have significant impacts and are highly likely. High risk also comes from low temperatures and heavy snow. Drought, wildfires, reservoir overtopping, heat waves and major flooding also pose a threat (States of Jersey, 2014b). With climate change, these unpredictable seasonal weather patterns could become more frequent.

The achievement of four of the Future Jersey outcomes could be impacted by all six priority risks identified in the UK Climate Change Risk Assessment.

1. Safety and security, including the protection of people's health and safety and Jersey's ability to respond to major emergencies. Health and safety could be at risk from climate change due to the increasing occurrence of; over-heating, new diseases and flooding. Similarly, there is an increasing risk from natural disasters such as storm surges which will require emergency planning at community and corporate level resulting in safety concerns,
2. Health and well-being, physically and mentally are at risk from climate change. This includes risks to health from invasive pests and diseases, possible changes in food security and potential risk to public water supply. It also includes the possibility of overheating and flood related health risks. Mental health risks arise from concerns about the impact of the increased possibility of flooding and from damage to natural environments.
3. The natural environment is at risk due to habitat loss and damage and changes in biodiversity either from climatic changes or invasive species. There is also the potential for the pollution of freshwater and marine resources.
4. Sustainable resources are at risk as a potential increase in surface run-off from storm events results in the leaching of pollutants into water courses. Groundwater supplies may also be impacted by temperature and recharge rate changes. In 2010 and 2011, two successive droughts caused water shortage fears whilst increasingly frequent storm events have:
   a) Overwhelmed the drainage system in 2010
   b) Left 11 parishes without power in 2013
   c) Caused a grounding of fishing vessels and ferry crossing, also in 2013 (Ellis & Smith, 2015).

However, it is also important to recognise that risks to other areas cannot be ignored. The risks that climate change poses are important for all Future Jersey outcomes and action will be needed to mitigate these risks.

Table 2 - Assessment of the climate change risks to the Future Jersey outcomes

Future Jersey Outcomes		Risks/Concerns					
		Flood	Temperatures	Water supply	Nature	Food scarcity	Pests/disease
Community	Safety and security	Damage to people and infrastructure	Increased risk of fires	Reduced ability to fight fires	Marine and land habitat change, loss of natural flood defences	Risk to food availability	Risk to public health from pests and diseases
	Learn and grow	Perception of loss of safety at home and work	Healthy living environments in danger			Risk to food availability	Risk to public health from pests and diseases
	Health and wellbeing	Mental health impacts from fear of flooding	Risk to human health from overheating	Risk to public health from poor water supply	Negative impacts on mental health and wellbeing	Risk to food availability	Risk to public health from pests and diseases
	Vibrant and inclusive	Damage to infrastructure and resources			Detrimental landscape change		
Environment	Built and historic environment	Damage to St Helier as it is low lying	Risk to human health from overheating	Risk to public health from poor water supply	Detrimental landscape change		
	Natural Environment	Damage to habitats	Temperature change impact on biodiversity	Pollution of freshwater resources	Marine and land habitat and biodiversity change	Biodiversity and habitat loss, risks to food availability	Native species loss
	Sustainable resources	Damage to resources	Risk to human health	Pollution of water supply and impact on fresh water recharge rate	Marine and land habitat and biodiversity change	Risk to food availability	Native species loss and disease threat

Future Jersey Outcomes		Risks/Concerns					
		Flood	Temperatures	Water supply	Nature	Food scarcity	Pests/disease
Economy	Attractive business environment	Increased insurance costs, resource and infrastructure damage, perception of reduced safety of investment				Perception of reduced safety of investment	
	Jobs and growth	Possible damage to competitiveness and attractiveness of Jersey	Risk to health of employees			Risk to levels of food exports and health of working population	
	Affordable living	Increased insurance costs					

Key	Description
	High risk
	Medium risk
	Low risk
	Very low or no risk

3 Overview of wider Impacts of Climate Actions

For the purpose of this report, the mitigation and adaptation actions currently happening in Jersey have been grouped into 8 themes. To create these themes, over 20 key documents were reviewed (e.g. Pathway 2050: An Energy Plan for Jersey, Jersey Coastal Management Plan and the Island Plan). All climate change actions in Jersey were identified with key themes developed. Through engagement with relevant States of Jersey and private stakeholders, these themes were refined further into the following:

- Active travel – particularly walking and cycling
- Public transport and infrastructure – the provision of frequent, reliable and affordable public transport
- Alternative fuel vehicles – including the adoption of low emission and electric vehicles
- Energy efficiency – reducing the energy demand from public, private and residential buildings
- Renewable energy in the domestic sector – micro-scale renewables to accommodate household demand
- Sustainable agriculture – including anaerobic digestion, reduction in fertiliser use and education of farmer in sustainable land management
- Adaptation to sea level rise and extreme weather events – particularly sea defences and Integrated Coastal Zone Management
- Behaviour change and communications – demand management and changes in behaviour to promote a more sustainable way of life.

Each theme therefore relates to a section of this report, outlining the actions that are relevant. The wider impacts of these actions are analysed in the context of the Future Jersey outcomes. Synergies and potential conflicts are then highlighted. At the start of each section an overview of the wider impacts is presented in the form of a matrix. This indicates direction (positive or negative) and magnitude. Further information on the methodology can be found in Appendix 1.

Table 3 - An overview of the strength and direction of wider impacts of climate change actions on the Future Jersey outcomes

			Jersey Climate Actions							
			Active Travel	Public Transport and Infrastructure	Alternative Fuel Vehicles	Energy Efficiency	Renewable Energy in the Domestic Sector	Sustainable Agriculture	Adapting to Sea Level Rise and Extreme Weather Events	Behaviour Change and Communications
Future Jersey Outcomes	Community	Safety & Security	-	+	0	0	0	0	++	0
		Learn & Grow	0	0	0	0/+	0	0/+	0/+	0/+
		Vibrant & Inclusive	0/+	++	0	0/+	0	+	0/+	0
		Health & Wellbeing	++	+	++	++	0/+	+	++	++
Future Jersey Outcomes	Environment	Built & Historic	+	++	0/+	0/+	0	+	++	0/+
		Natural Environment	0/+	0	0/+	+	0/-	++	+	+
		Sustainable Resources	++	+	++	++	++	++	++	++
	Economy	Affordable Living	+	++	0/+	++	+	0	+	++
		Attractive Business Environment	+	+	+	+	+	0	+	+
		Jobs & Growth	+	+	+	+	+	+	+	+

Matrix Key	Description
-	Negative - this climate action could conflict with the Future Jersey outcome, caution should be taken
0/-	Neutral or slightly negative - this climate action could have some conflict with the Future Jersey outcome
0	Neutral - this climate action will have little impact on the Future Jersey outcome
0/+	Neutral or slightly positive - this climate action could have some benefits for the Future Jersey outcome
+	Positive - this climate action could have benefits for the Future Jersey outcome
++	Strongly positive - this climate action could have significant benefits for the Future Jersey outcome

4 Active travel

4.1 Mitigation and Adaptation Actions

Using the Island Plan to support action and planning, Jersey aims to reduce the number of journeys taken at all times by 5% by 2020, compared to a 1990 baseline. The Island Plan aims to encourage the travel demand reduction by car by enabling and encouraging alternatives and minimising the construction of new roads (States of Jersey, 2015c). This will not only reduce demand and influence travel choices but will also reduce pollution and noise caused by transport. One key aspect is the promotion of active travel, walking and cycling, to replace short distance journeys made by private cars.

A modal shift to active travel will prompt significant decreases in greenhouse gas (GHG) emissions from urban transport. In Europe, a combination of measures to promote more sustainable travel could reduce GHG emissions by 50 % between 2010 and 2040 (Creutzig, 2015). The greening of transport corridors, as mentioned above, can also enhance resilience to climate change as the design of green transport corridors can take into account water management whilst also providing well-being benefits (Active Transport for Healthy Living Coalition, 2014). Sustainable drainage can reduce flooding with health, environmental and economic benefits.

Box 1: Sustainable Transport Policy progress 2010 to 2015

Between 2010 and 2015, the Sustainable Transport Policy has achieved the following:

- The introduction of 100 new bicycle stands in town and 50 out of town
- A reduction in the number of public commuter spaces provided
- The provision of viable alternatives to private cars which has paved the way for a review (and increase) in parking prices
- New crossing facilities at various locations

(States of Jersey, 2015c).

The Sustainable Transport Policy sets congestion management targets for reducing the number of private vehicle journeys. It also supports modal shift and promotion of active travel in Jersey through actions including improved public transport provision, improved active travel infrastructure and travel plans for workplaces and schools. Financial measures are employed to limit the number of private car journeys (increasing parking charges and limiting the number of long stay parking facilities) and this incentivises the use of more sustainable transport options. New developments will prioritise walking and cycling, providing both physical and financial contributions to pedestrians and cyclists. Progress to date was measured in the update report, a summary of which is found in **Box 1**.

4.2 Wider Impacts

Table 4 - Overview of the strength and direction of wider impacts for active travel policies

Future Jersey Outcomes	Climate Action: Active Travel
Safety and security	-
Health and wellbeing	++
Built and historic environment	+
Sustainable resources	++
Affordable living	+
Attractive business environment	+
Jobs and growth	+

Table 4 provides an overview of the wider impacts relating to the Future Jersey outcomes and indicators arising from active travel policies. Active travel has a wide range of potential benefits beyond the reduction of greenhouse gases. These include the reduction of congestion, improvements in public health and wider environmental benefits from the reduction of air pollutants (Wilson & Cope, 2011, Brown, et al., 2016, Tainio, et al., 2016). Active travel interventions - infrastructure and softer measures relating to behaviour change campaigns - have been shown to have a net positive result in cost benefit analysis. The benefits relate to health, air pollution and reduced car use outweigh the costs required to implement active travel measures (Wilson & Cope, 2011). The benefits of cycling, when replacing time driving a car, always exceed the health risks from exposure to background air pollution in urban areas. This is partly because exposure to air pollution is greater inside a car. These benefits are the case in all cities where background air pollution is below 80 µg/m3 of $PM_{2.5}$ and this occurs in 98% of cities globally (Tainio et al., 2016). However, there is also an increased risk of accidents and this risk is higher in younger age groups (Woodcock, et al., 2014). Infrastructure design and traffic management is key to addressing this risk. Overall, it is therefore clear that significant wider benefits can be gained from active travel interventions (**Box 3**).

Community: Safety and Security

Road accidents are one area where active transport policies may have a negative impact due to the risk of accidents. Walkers and cyclists are less protected than car users and are therefore more likely to get injured when involved in an accident. Walkers and cyclists account for 46% of road traffic deaths globally (WHO, 2011a). However, this figure varies greatly by location and can be reduced with high quality infrastructure, safety provisions, driver awareness raising and speed restrictions. A recognition of this potential conflict between active travel and road safety is important and it highlights the need for careful planning and safety considerations when implementing active travel policies.

Community: Health and Wellbeing

Unhealthy diet and lack of exercise are the cause of two thirds of attributable deaths in high-income countries with cardiovascular disease and stroke being leading causes of death in 2015 (WHO, 2009, WHO, 2016, Howden-Chapman, et al., 2015). In Jersey, a third of children age 10 to 11 are overweight and just 1 in 5 are physically active for at

least an hour a day (States of Jersey, 2016a). Higher levels of air pollution in cities are associated with higher death rates due to an increased risk of cardiovascular and respiratory disease, cancer and adverse birth outcomes (WHO, 2011a). Cancer, circulatory disease (e.g. coronary artery disease and strokes) and respiratory disease (e.g. asthma and bronchitis) caused 71% of all attributable deaths in Jersey between 2013 and 2015 (States of Jersey, 2016a). An ageing population could also be contributing to this pattern. Physical inactivity also contributes to the burden from non-communicable diseases as the risk of obesity, coronary heart disease, strokes and diabetes are increased, among others (Brown, et al., 2016).

The health benefits obtained through active travel are proven to outweigh potential harm from exposure to air pollution (Tainio, et al., 2016). Active travel therefore has health benefits due to the reduction of harmful air pollutants and the promotion of physical activity. The disease burden from chronic disease is lowered by active travel measures as obesity is reduced, people are exposed to the benefits of vitamin D and cardiovascular functioning is improved (WHO, 2011a, Howden-Chapman, et al., 2015, Brown, et al., 2016, Jensen, et al., 2013). A reduction in disease burden has additional economic benefits as health care costs are reduced, relieving pressure on health services and potentially contributing to a public-sector deficit reduction in the UK (Jensen, et al., 2013).

Environment: Built and Historic Environment

Investment in cycling infrastructure can improve accessibility to local amenities and public transport with small investments making large improvements. Investment is particularly efficient if active travel routes are integrated with transport hubs such as bus stations and railway stations (Lucas & Pangbourne, 2014). The Sustainable Transport Policies of Jersey aim to encourage active travel by making it the favourable option. This contributes to a behaviour change where active travel becomes the norm because it is the most convenient, cheapest and easiest.

Environment: Sustainable Resources

In the UK, 40,000 deaths per year can be attributed to exposure to outdoor air pollution (Muirie, 2017). A disproportionate amount of this air pollution comes from car journeys that cover short distance. This is for two reasons; emissions from cars are highest when the engine is first started and the operating temperature is lower, and more than half of car journeys are five miles or less. However, it is short journeys that are most suited to active travel measures. This raises the potential for large improvements in air quality and associated health benefits through the reduction of nitrous oxides (NO_x) and particulate matter (PM) (Muirie, 2017). The Sustainable Transport Policy for Jersey promotes active travel within schools. For every child walking one mile to school instead of being driven, 57kg of carbon is saved per year (Active Transport for Healthy Living Coalition, 2014). One way in which active travel can be encouraged is through the “greening” of transport routes. "Greening" is the process of increasing the amount of vegetation and green space. This can have additional benefits for urban areas including: improved air quality, a reduction in the urban heat island effect, increased biodiversity and the provision of space for sustainable drainage (Active Transport for Healthy Living Coalition, 2014). Smith et al (2015) suggests that, in the UK, congestion reduction could offer benefits with a Net Present Value of £48 billion between 2008 and 2030. These benefits are important for health of the people, the economy and the environment.

Economic: Affordable Living

Active travel measures could help Islanders to afford a decent standard of living because the cost of travel is reduced (Lucas & Pangbourne, 2014). For cycling, after the initial outlay of buying a bicycle, the costs are very low and costs of walking are even lower (**Box 2**). Investment in facilitating active travel can also provide people with better access to services such as health centres. Among more deprived communities better access to services can increase quality of life as there are more opportunities for health care, jobs and increased mobility (Mackett & Thoreau, 2015).

Social inclusion is an important consideration to maximise benefits. Whilst cycling reduces the cost of travel, take up is often highest among affluent white men (Lucas & Pangbourne, 2014) and therefore thought needs to be given as to how to encourage uptake in other social groups. Similarly, rural and elderly populations are at higher risk of social exclusion and are more likely to be dependent on car travel. Therefore, creating highly walkable environments for these communities could have significant benefits, if services and amenities are short distances. Elderly people in particular could feel the health benefits from increased active travel (Shergold & Parkhurst, 2012, Winters, et al., 2015).

Economic: Attractive Business Environment

There are mental health benefits from spending more time outdoors and increased physical activity which contribute to a healthier work force. A study in the United States found that short term sick leave could be reduced by up to 32% with 30 minutes of exercise a day. Active travel measures can therefore reduce absenteeism with economic benefits for businesses (Wilson & Cope, 2011). The expansion in available work force leads to an increase in Gross Domestic Product (GDP) (Jensen, et al., 2013).

Economic: Jobs and Growth

Cycling could contribute around £3bn to the UK economy each year through bike sales and manufacturing, lower pollution levels and lower health care costs and reduced congestion (Muirie, 2017). Those who cycle or walk in local areas are more likely to spend money than those that drive through and, whilst they spend less in one go, they make more frequent transactions. This can increase trade and revenue for local businesses, stimulating economic growth and vibrancy in urban areas and sustaining smaller, local shops (Muirie, 2017, Active Transport for Healthy Living Coalition, 2014). These benefits to the local economy can be enhanced by active travel plans that create pleasant urban environments as this encourages inward investment in the areas, increasing productivity, providing jobs and attracting skilled labour (Active Transport for Healthy Living Coalition, 2014).

Investment in transport, including public transport and active travel alternatives could increase employment opportunities if accessibility is increased. For example, those living in rural communities without access to a car could have access to previously unavailable jobs with the provision of alternative modes of transport. The work force would also expand due to the health benefits of active travel and increased physical activity with fewer people being unable to work due to ill health (Mackett & Thoreau, 2015, Wilson & Cope, 2011, Jensen, et al., 2013).

Box 2 - Case study: E-bikes in Jersey

Overview: From June 2016 to April 2017, the States of Jersey Department for infrastructure provided grants of up the £300 for individuals to buy E-bikes (bikes with electric motors) from local retailers. Of the 640 applications made to the scheme, 488 were converted into bikes.

Users of the E-bike scheme were asked to complete an online survey which revealed:

- 70% of owners used their bike to commute at least once a week and 34% used it four or more days a week
- 58% of users said that they had replaced travel by motor vehicle with travel by E-bike
- 63% reported feeling healthier and more active

"An E-bike feels safer than a conventional bike because the journey time is shorter and I can go up hill faster so there are fewer cars overtaking me" - An illustrative quote from a stakeholder, gathered as part of the workshop held to inform this study.

Further analysis of the data is needed to investigate the real extent to which E-bikes have replaced motor vehicle journeys and to what extent the scheme has contributed to changes in travel behaviour in Jersey. This scheme has now ended, however, a better understanding of the data and results could indicate whether a scheme such as this is appropriate in the future and whether and how changes could be made to maximise its effectiveness.

Box 3 - Case Study: Cost benefit analysis of an active travel intervention at a school in East Lothian, Scotland

Measures implemented: Construction of a traffic free path leading to the school which is surfaced and lit. Implemented in 2007.

Aim: Provide safer pedestrian and cyclists routes to and from the school by reducing the number of cars accessing the area around the school. This also provides a better route for the wider community to use.

Increase in active travel participants: Over 2 years, 343 adult cyclists and 127,000 adult pedestrians used the route annually. The number of children using the route increased from 12,883 to 18,225 annually for cyclists and from 97,781 to 99,074 annually for pedestrians.

Total cost of the project (adjusted to market price): £74,083

Estimated monetised benefits from the project over a 10-year period for adult pedestrians:

- Health benefits: £918,759
- Absenteeism benefits: £30,665
- Decongestion benefits: £16,709
- Amenity benefits: £25,509

Total benefit cost ratio: 13.4:1

(Wilson & Cope, 2011)

4.3 Potential Barriers

The most significant barriers to the uptake of active travel are peoples' perception and behaviour. For example, a perceived sense of danger can stop people (particularly children) from walking or cycling. This sense of danger can originate from worries including: too many cars, the traffic is too fast, drivers are inconsiderate and the exposure to pollution is too high (Muirie 2017, Brook, et al., 2017). In Jersey, roads are narrow and therefore there is limited segregation between walkers, cyclists and motor vehicles. This infrastructure challenges poses safety concerns that need to be addressed.

There can also be concerns about time efficiency as active travel can be perceived to take longer and be less convenient. Therefore, interventions which make driving less convenient can start to address the challenges. Awareness raising, prioritisation of active travel and promotion of active travel within schools contributes towards a shift in cultural norms towards more sustainable travel behaviours (Muirie, 2017, Lucas & Pangbourne, 2014). To maximise the uptake of active travel measures, they should be supported by public transport provisions.

As mentioned above, there is also a need for active travel actions to be location specific and tailored to take into consideration social inclusion. For example, lower income communities are less likely to take advantage of cycling and associated benefits due to the initial cost of owning a bike. Similarly, non-white ethnic groups and disabled users can be less likely to take up cycling. The ageing population in Jersey could also pose a significant barrier to active travel. Therefore, targeted initiatives that support these groups (such as easy access cycle-hire schemes) are needed to maximise the benefits and ensure equitable distribution of benefits (Lucas & Pangbourne, 2014, Brown, et al., 2016, Brook, et al., 2017).

5 Public transport and infrastructure

5.1 Mitigation and Adaptation Actions

Many of the Island Plan actions outlined in the Active Travel section are also applicable to public transport, including; the reduction in demand for travel by car, the encouragement of alternative travel modes and the minimising of new road construction (States of Jersey, 2015c). Public transport provisions are needed to support active travel measures, ensuring maximum uptake and efficiency of these policies. This enables integrated travel options, such as buses with bike racks, making sustainable travel choices readily available, affordable and convenient.

The reduction in the number of journeys made by private car will stimulate a reduction in GHG emissions, including CO_2, black carbon, NO_x and methane. However, these reductions will be most significant when increasing use of public transport is coupled with clean transport vehicles (for example, electric buses instead of diesel) (Woodcock, et al., 2009). To "lock-in" the GHG mitigation benefits, complementary measures need to be considered such as road reallocation and the promotion of alternative fuels (Skinner, et al., 2011).

The Sustainable Transport Policy aims to promote the modal shift to active travel and the use of public transport. It aims to; increase bus use, provide a higher frequency of service on certain routes and at peak times, improve transport hubs and shelter, provide better information on routes and increase bus among school pupils, among other policies. The quantitative goals of this policy include:

- Double the number of bus passengers at peak times by 2015
- Increase public transport use among school pupils by 20% by 2015 (States of Jersey, 2015c).

There has also been investigation into; the use of existing car parks at St John for park and ride provisions, bus priority and the provision of late night bus services.

Box 4: Sustainable Transport Policy progress 2010 to 2015

Between 2010 and 2015, the Sustainable Transport Policy has had the following results:

- Seating capacity on buses at peak time has increased by 23%
- Departures of most services are now at a consistent time during the day
- Evening services enhanced on core corridors and additional Sunday services provided where viable
- New circular service introduced
- Funding for town hopper service not available and park and ride trial at St John was not successful. There are no further plans to provide this service
- Key transport hubs highlighted in publicity material and provision of information has improved but there is a need for further improvements to information provision including app and website development
- Further analysis of school pupil bus usage is needed
- Road infrastructure constraints pose a challenge to bus priority

(States of Jersey, 2015c).

5.2 Wider impacts

Table 5 - Overview of the strength and direction of wider impacts arising from policies to promote public transport

Future Jersey Outcomes	Climate Action: Public transport and infrastructure
Safety and Security	+
Vibrant and Inclusive	++
Health and Wellbeing	+
Built and Historic Environment	++
Sustainable Resources	+
Affordable Living	+
Jobs and Growth	+

Community: Safety and Security

With active travel, the risk of increased road accidents was highlighted as an area where caution must be taken. A reduction in the volume of traffic through the provision of public transport could reduce this risk and increase the safety of active travel, especially at peak times. A well developed, reliable and frequent public transport service that is widely used could reduce the potential for traffic accidents (Kwan & Hashim, 2016).

Community: Vibrant and Inclusive

The Sustainable Transport Policy progress report highlights that the enhancement of services between Gorey and the Airport has made the interchange in St Helier more attractive (States of Jersey, 2015c). This in turn attracts more people to the area and more visitors, contributing to a vibrant community. Public transport also increases inclusiveness as it is low income groups that benefits the most from the provision of an affordable and reliable bus service (e.g. the elderly, disabled and lone parents). This is especially the case when measures are in place to reduce the cost of public transport, such as concessionary charges. These vulnerable groups have better access to employment opportunities and other service, such as health care through affordable transport provisions (Lucas & Pangbourne, 2014).

Community: Health and Wellbeing

The health benefits gained from public transport provisions may not be as great as those gained from a modal shift to active travel, however they are still worth considering. Health benefits from increased physical activity may be gained if users travel to and from bus stops by walking or cycling. Simply standing at the bus stop can also have health benefits when replacing time spent sat in the car as it decreases sedentary behaviour (Kwan & Hashim, 2016, Lucas & Pangbourne, 2014). In achieving the benefits of physical activity, urban design and local culture and behaviours must be considered. It is possible that health benefits will not be gained if public transport replaces active travel as the preferred mode of transport (Kwan & Hashim, 2016). Careful planning and dissemination of information on multiple benefits is needed if this is to be avoided.

In an ageing population, improved public transport services may have greater health and wellbeing benefits. Provided these services are accessible (e.g. nearby and step free), they can allow elderly people access to areas where they can participate in physical activity, such as parks and day centre. This encourage a healthy lifestyle with associated health benefits (Mackett & Thoreau, 2015, Lucas & Pangbourne, 2014, Sloman, et al., 2010). Mental health and wellbeing benefits are also gained by the elderly through the development and maintenance of social connections and associated decrease in isolation. This decreases the mortality risk among elderly populations (Mackett & Thoreau, 2015). It is also possible to transfer the lesson learnt through public transport provisions to other policies such as the promotion of sustainable behaviours and health promotions (Sloman, et al., 2010).

Environment: Built and Historic Environment

An independent survey of bus users, carried out by Liberty Bus in 2014 showed that 56% mainly use the bus during peak hours in the morning and afternoon and 52% reported the primary reason for use as being to commute to and from work (States of Jersey, 2015c). There is clear potential for public transport to deliver increased reductions in peak time congestion. Congestion relief allows Islanders to travel around more easily and can improve access to certain areas (Smith, et al., 2015, Bureau, 2011).

Environment: Sustainable Resources

Congestion reduction through public transport offers emissions reduction and also wider impacts in the form of improved air quality and reductions in noise (Kwan & Hashim, 2016, Smith, et al., 2015). However, these benefits are offset if public transport vehicles are polluting, for example old diesel buses. Therefore, to maximise the health and environmental benefits of reduce air and noise pollution, the public transport provisions must include cleaner and quieter vehicles, such as electric buses. These benefits are also maximised when pedestrians are separated from traffic, air quality improving with distance from the source (Kwan & Hashim, 2016, Smith, et al., 2015).

Economic: Affordable Living

Whilst high income groups are more likely to benefit from cycling infrastructure, low income groups, women, young people and the elderly are more likely to benefit from improvements to bus infrastructure (Skinner, et al., 2011). Therefore, a combination of public transport and active travel measures will target a wide range of the population. The provision of affordable and reliable public transport allows vulnerable groups access to services such as health care (Skinner, et al., 2011).

Economic: Jobs and Growth

The provision of affordable, reliable public transport services can allow vulnerable groups and those living in rural areas access to employment opportunities (Skinner, et al., 2011). This not only provides a means of affordable living for the individual but also increases the size of the workforce in Jersey. A higher percentage of the population can engage in economic activities, increasing the productivity of the population.

5.3 Potential barriers

The cost of public transport could be a barrier to the lowest income users. It is becoming increasingly expensive and this can prevent, for example, young people engaging in education or unemployed accessing jobs. Subsidies and concessionary fares is one solution to this barrier however this would need to be carefully planned. The cost of administering such a system could result in peripheral services losing funding in favour of core routes. This would further disadvantage communities that already experience low level of public transport services (Lucas & Pangbourne, 2014, Mackett & Thoreau, 2015). It is therefore important to identify where vulnerable populations are living and what specific challenges they face. This will allow for targeted and resource efficient policies.

Whilst public transport may offer improved road safety due to reduced volumes of traffic, the perception of safety could still pose a barrier. Safety concerns could arise when having to walk to and from a bus stop in the dark or in an unknown place (Mackett & Thoreau, 2015). This barrier could be minimised through infrastructure provision; bus stops at regular intervals to avoid long walking distances, good lighting on streets and the provision of maps of the local area.

Limited information can also be a barrier to the use of public transport. People may not know what services are available or may not be able to easily access the information they need. For example, elderly or low-income users may not be able to access online solutions, such as apps that are cheap to provide and easy to maintain, due to the lack of a smart phone (Mackett & Thoreau, 2015). The survey conducted by Liberty Bus showed that 35% of people used the paper timetable, 27% used the timetable on the mobile site via a smart phone and 22% used the online timetable via a computer (States of Jersey, 2015c). This highlights the need to provide information in several formats to ensure that all user groups have access to the information that they need. This information should be readily available, up to date and make the use of public transport easy and convenient.

6 Alternatively fuelled vehicles

6.1 Mitigation and Adaptation Actions

Jersey plans to reduce emissions from road transport by increasing the number of Ultra Low Emissions Vehicles (ULEVs), mainly electric and hybrid vehicles. There is a target for uptake of ULEVs; 10% of new cars registered by 2020, 30% by 2030 and 90% by 2050. More stringent EU emissions standards for cars and vans have come into force. By 2020 only vehicles which comply with these standards can be registered. The 'Eco-permit' scheme will support efforts towards the ULEV take up target, offering a discount on parking charges of 50% for low emission vehicles (States of Jersey, 2014a).

The Sustainable Transport Policy aims to achieve a 5% shift to sustainable modes of transport by 2020 and this includes ULEVs. This will be achieved through the provision of additional charging points and reserved spaces in advantageous positions. The policy will also monitor the uptake of ULEVs, tracking numbers of vehicles and vehicle usage. It will look to identify barriers to ULEV uptake and investigate possible incentives for encouraging greater uptake. Between 2010 and 2015, the eco-permit scheme has been implemented consistently and every multi-storey car park now contains two or more spaces reserved for ULEVs with charging points (States of Jersey, 2015c).

6.2 Wider impacts

Table 6 - Overview of the strength and direction of wider impacts arising from policies to promote alternative fuel vehicles

Future Jersey Outcomes	Climate Action: Alternative fuel vehicles
Safety and Security	0
Health and Wellbeing	++
Sustainable Resources	++
Jobs and Growth	+

Community: Safety and Security

A potential conflict between this Future Jersey outcome and the expansion of ULEVs exists which must be considered. Due to the quiet nature of ULEVs, there may be a heightened risk to walkers and cyclists with an increased chance of accidents as active travellers rely on their hearing to identify dangers (WHO, 2011a). This conflict can be minimised through planning and prioritisation of walkers and cyclists and the fitting of noise devices. Infrastructure developments to make walking and cycling routes safer, such as good lighting and provision of crossings can help to reduce the chance of accidents.

Community: Health and Wellbeing

The uptake of ULEVs can contribute to the reduction of air pollution, leading to significant health benefits (Smith, et al., 2015, WHO, 2011a, Pollitt, et al., 2014). Smith, et al. (2015) predict that the introduction of electric vehicles could have air quality health benefits totalling £32 billion in 2030 in the UK. Jersey has a high turnover of

vehicles with an average of 7,326 vehicles registered per year between 2011 and 2016. Therefore, more polluting vehicles will be replaced with newer, less polluting vehicles at a relatively fast rate. Health benefits can also be gained from the introduction of ULEVs due to reduced noise exposure. ULEVs are much quieter than conventional cars and therefore have benefits for mental and physical health (Smith, et al., 2015, WHO, 2011a). As well as improvements in quality of life from noise reduction, there may also be increases in house prices for homes near roads.

Environment: Sustainable Resources

The increased uptake of ULEVs can contribute to enhanced energy security as it reduces the demand for imported fossil fuels. Fuel prices can be volatile and vulnerable to shocks whilst electric vehicle and battery costs are declining as demand increases. This creates a major driver for investment in ULEVs (Traut, et al., 2012). Electricity in Jersey is currently sourced from France via three interconnectors. It is possible that the increased demand for electricity for cars could stimulate an increase in the uptake of renewables. This would not only provide a clean source of energy for cars but would increase energy security as Jersey would be less reliant on the interconnectors.

The introduction of ULEVs is also associated with health benefits. ULEVs have reduced levels of NO_x, carbon monoxide (CO) and PM which are all air pollutants that cause harm to the health of humans and the environment (Cruickshank & Kendall, 2012, Buekers, et al., 2014). A study conducted on the introduction of ULEVs in Coventry, UK found that levels NO_x and CO were significantly reduced. Levels of CO_2 were not significantly reduced however this was attributable to the fact that the electricity used to power the vehicles was predominantly non-renewable (Cruickshank & Kendall, 2012). There will still be emissions of certain particulates due to brake and tyre wear however these are not significant enough to outweigh the overall benefits of the switch.

A study by Buekers, et al. (2014) compared the impacts of a switch to electric vehicles across the EU-27 countries. The largest benefits for health and the environment were achieved in France (the source of electricity in Jersey) where more than 70% of energy was generated by nuclear in 2010. Emissions reductions gained from switching to electric vehicles were maximised as benefits were not offset by more carbon intensive energy production. With a 5% penetration rate, average annual mileage of 10,000km and estimated fuel mix for 2030, the annual health and environment benefits estimated for France totalled 104 million euros (Buekers, et al., 2014). This study therefore demonstrates that the air quality benefits to be gained from the uptake of ULEVs in Jersey could be significant financially. However, the health and environment benefits are not as great as those that can be gained by switching from cars to active travel.

Economic: Jobs and Growth

The uptake of ULEVs has the potential to stimulate economic benefits in the form of jobs and growth in the green economy. The additional investment in low-carbon vehicles could contribute to a jobs and GDP growth in Jersey if parts of the maintenance process or supply chain were to be based in Jersey (Pollitt, et al., 2014). There could also be indirect economic benefits for other sectors, such as renewable energy. For example, one challenge of renewable energy is storage as sources can be intermittent. Electric vehicles could fill this role acting as both transport and energy storage. There is potential for this to stimulate the growth and development of wind technology in conjunction with electric vehicles (Buekers, et al., 2014). ULEVs could open up opportunities for Jersey based companies to supply innovative products and jobs in the electric vehicle industry.

Box 5 – Case study of incentives for the uptake of electric vehicles in Norway (Bjerkan, et al., 2016)

Norway has the highest market share by battery electric vehicles globally.

In a survey of 3400 electric vehicle owners, more than 80% pointed to tax and VAT exemptions as critical incentives for buying the vehicle. This demonstrates that a reduction in the up-front cost of the vehicle is one of the most effective incentives for electric vehicle adoption.

Other incentives that were identified as effective included:

- Exemption from road tolls
- Access to bus lanes

6.3 Potential Barriers

One of the most significant barriers to the uptake of ULEVs is the initial cost of purchase, as well as fears about the driving range. For many, buying a new car is a big investment, therefore schemes that incentivise and reduce this cost are attractive; for example, trade in options that offer financial rewards (Cruickshank & Kendall, 2012, Traut, et al., 2012). However, people are reluctant to invest in a new technology unless it is easy, proven and advantageous. Here lies a problematic cycle; manufacturers only want to make products for which there is a proven market, whilst consumers will not invest in ULEVs if there is no refuelling infrastructure, and refuelling infrastructure projects will not be taken on by anybody if ULEVs do not exist in high enough numbers (Traut, et al., 2012). Therefore, policy makers need to overcome this barrier through targeted, carefully designed measures such as incentives, taxes and regulations. These measures need to be relevant to the population and consider the local socio-economic situation. Jersey has already started to implement charging points in car parks however there could be a greater number provided near properties. The next step is to make to publicise the location and availability of charging points and consider whether it is appropriate to incentivise the uptake of electric vehicles

7 Energy efficiency

7.1 Mitigation and Adaptation Actions

Jersey aims to reduce energy consumption by 25% by 2020 and 15% by 2020 for the public and private sectors respectively, compared to a 'business as usual' scenario. In the private sector, energy consumption will decrease by a further 10% every decade thereafter (States of Jersey, 2014a). There will also be further consideration of the potential savings from energy efficiency measures in the private sector, including an assessment of whether fiscal measures are needed to incentivise energy efficiency expenditure.

The Department of the Environment sets out energy efficiency measures for the domestic, private and public sectors. The Energy Plan proposed that a 'low carbon' standard be introduced for new homes through Building By-Laws. Part 11 of the Bye-Laws cover the energy efficiency of new and existing dwellings and were updated in 2016 ahead of the target date of 2018 in the energy plan. The Energy Efficiency Service ran from 2009 – 2015 and provided a 100% turnkey grant service for socially vulnerable households. Over 1700 homes were insulated through the programme. The Energy Plan sets out actions to encourage the installation of energy efficiency measures in the able to pay sector focussed on properties built before 1997 when the first energy standards were introduced in building bye laws. These properties are likely to have a lower thermal performance. The measures could include the development of improvement packages for properties, incorporating measures such as: insulation, draught proofing, heating upgrades and glazing upgrades (States of Jersey, 2014a). An accredited training programme for energy efficiency installers will commence in 2018 to increase capacity and confidence in the local market place and access to accredited installers for all householders. The Rent Safe Scheme informs tenants of which properties meet the scheme's standards. These standards relate to energy efficiency, health and safety and compliance with legal standards. The star rating system shows tenants which homes are most energy efficient (States of Jersey, 2017c).

Climate change could increase the number of extreme weather temperature events in Jersey. Improvements in energy efficiency, through measures such as insulation, improved heating and draft proofing, can help in managing and adapting to this threat as they help to regulate indoor temperatures and protect against outdoor temperature extremes (Howden-Chapman, et al., 2015). The reduction in energy demand as a result of these measures can also help to increase energy security, mitigating against shocks and failures in supply. If Jersey was to implement the proposed energy efficiency measures successfully, this would reduce demand and help meet the 14-day energy security standard. This means that the energy supply could be maintained for 14 days were an event to happen which damaged of delayed fuel storage or import infrastructure (IPA, 2013).

The eco-active business network provides businesses with support for reducing their energy use, allowing them to reduce energy costs, contribute to Jersey's energy emissions reduction target and show their commitment to the environment. The programme offers energy saving information to businesses and offers site visits to certain businesses to: review the main areas of energy use, set up energy monitoring, identify where energy efficiency can be easily and quickly improved and identify areas for long term improvement (States of Jersey, 2017a).

7.2 Wider impacts

Table 7 - Overview of the strength and direction of wider impacts arising from energy efficiency measures

Future Jersey Outcomes	Climate Action: Energy efficiency
Health and wellbeing	++
Vibrant and Inclusive	+
Sustainable Resources	++
Affordable Living	++
Jobs and Growth	+

Community: Health and Wellbeing

Energy efficiency measures are often associated with improvement in the indoor environment, such as a reduction in mould and exposure to extreme temperatures and improved ventilation. This has major health benefits through the reduction of noncommunicable diseases such as asthma, heart disease and respiratory disease (IEA, 2014, WHO, 2011b, Howden-Chapman, et al., 2015). Exposure to outdoor extreme temperatures is associated with an increased risk of respiratory and coronary conditions. Improvements in insulation therefore reduce this risk by regulating indoor temperature, providing good ventilation is in place (Howden-Chapman et al., 2015, Smith, et al., 2015, Sovacool, 2015, Pollitt, et al., 2014).

Benefits can be gained through the reduction of energy bills, reducing fuel poverty and providing access to decent living conditions for a greater number of people (IEA, 2014, WHO, 2011b). As highlighted through the Home Energy Scheme review (**Box 7**), the savings on energy bills may not be as high as expected among vulnerable populations. However, this money is often invested in maintaining a more comfortable living environment and this has significant health benefits (States of Jersey, 2016b). Vulnerability to respiratory and circulatory disease and winter deaths due to exposure to the cold are highest among the fuel poor. Energy efficiency measures reduce the cost of maintaining "thermally comfortable" living conditions and its benefits are felt most strongly among the fuel poor. Wider health impacts are gained as the money saved on heating is available for food and basic commodities (Sovacool, 2015). There are also benefits to mental health. The alleviation of extreme indoor cold conditions in the winter, the reduction in fuel costs and the associated additional income from energy efficiency measures can reduce depression and improve overall mental health (Jensen, et al., 2013, WHO, 2011b).

Community: Vibrant and Inclusive

Analyses of the costs and benefits of energy efficiency measures in housing frequently show these measures to have positive overall economic impacts as the health benefits gained from increased energy efficiency outweigh the costs of investment (Howden-Chapman, et al., 2015, Jensen, et al., 2013, Pollitt, et al., 2014). The health and welfare benefits that are gained through increased energy efficiency in the domestic sector are felt most strongly amongst vulnerable groups; the elderly, children and those living with

illness or disability (IEA, 2014, Sovacool, 2015). A larger number of houses are "thermally comfortable" and this leads to health benefits, especially amongst fuel poor households (Sovacool, 2015). A holistic, broad approach is needed when assessing the health benefits from energy efficiency measures. In a purely economic assessment, measures can have negative economic impacts as life expectancy increases and therefore welfare by GDP per capita decreases. It is, however, the physical and mental health benefits that make these measures net positive in terms of economic impacts (Jensen, et al., 2013).

Environment: Sustainable Resources

Improvements in energy efficiency could reduce the amount of air pollution. Air pollutants can cause harmful impacts on the natural environment, such as eutrophication and acidification. Exposure to ground-level ozone can constrain ecosystem growth and functionality, inhibit crop growth and disturb water ecosystem ecological balances (Mzavanadze, 2015). In Jersey, energy efficiency measures could help towards protecting ecosystems and natural habitats that are considered part of the Jersey identity.

The International Energy Agency (IEA) define four dimensions of energy security; availability, accessibility, affordability and acceptability (**Box 6**). Measures that reduce demand through energy efficiency increase energy security across all four dimensions. Energy efficiency measures have been shown to be one of the most cost-effective solutions for cutting carbon emissions with energy savings outweighing initial installation costs considerably (Pollitt, et al., 2014). When combined with a greater diversity of energy sources (for example renewable energy in the domestic sector in Jersey), energy security is increased and the supply is less vulnerable to supply disruptions (Pollitt, et al., 2014).

Box 6 - Four dimensions of energy security, IEA (2014).

- Fuel availability – is there an energy source that is geologically or locally available?
- Fuel accessibility – Are there geopolitical barriers to the availability of the energy source?
- Affordability of energy – Is it economically feasible to access the energy?
- Acceptability – Is the energy source acceptable both environmentally and socially?

Economic: Affordable Living

Fuel poverty arises from poor quality housing with increasing energy costs combined with constant or decreasing household income. Measures to improve energy efficiency reduce energy bills as less energy is needed to maintain the house at a comfortable temperature. This allows more people access to affordable energy, especially poorer households. This alleviates fuel poverty with multiple health benefits, as described above (IEA, 2014, Mzavanadze, et al., 2015). Given the high costs of living in Jersey, fuel poor households may need financial assistance to improve energy efficiency. For example, from 2009 to 2015, the Home Energy Scheme (**Box 7**) provided grants for domestic energy efficiency improvements for socio-economically vulnerable people in Jersey. There is also a need for technical measures to be combined with demand reduction and this can be encouraged through behaviour change campaigns.

Box 7 – Case study: Home Energy Scheme, Jersey 2009 to 2015

Background: The Home Energy Scheme ran from 2009 to 2015 and provided grants to socio-economically vulnerable people in Jersey for household energy efficiency improvements. Improvements included loft insulation, cavity wall insulation and upgrades to heating system with the aim of reducing energy consumption and contributing to carbon reductions.

Challenges:

- Carbon and financial savings were lower than expected as clients used energy savings to enable an increase in the temperature of the house. However, given the vulnerable nature of the client group, this will have had significant health and well-being benefits.
- Due to Medium Term Financial Plan budget changes, the Home Energy Scheme stopped operating in 2015. In its lifetime, the scheme successful helped 1,744 vulnerable Islanders.

Headline *benefits:*

- Environmental - improved energy efficiency of homes and reduced energy demand. Nearly 4,000 tonnes of lifetime carbon savings and nearly 229GWh of lifetime energy savings.
- Economic - £18million savings from reduced energy use. Also, economic and labour benefits for local firms that were employed to carry out the work. A good return on investment.
- Community - reduced energy bills, increased thermal comfort and associated health benefits for the most vulnerable sector of the community.

(States of Jersey, 2016b)

Economy: Jobs and Growth

There are short and long term economic benefits to investing in energy efficiency. In the short term, investment in the energy efficiency of public buildings can help protect against economic downturn as the additional investment boosts economic activity (Naess-Schmidt, et al., 2015). In the long term, economic benefits can be gained from increases in productivity of the business and the workforce. Business productivity is increased as resource use and pollution are reduced and therefore operation and maintenance costs are lower. This reduces the need for imports and increases potential

profits (IEA, 2014). For the workforce, the health benefits of energy efficiency measures at home and at work can boost productivity (**Box 8**). Reduced absenteeism will have long-term economic benefits to the individual, company and country (Naess-Schmidt, et al., 2015).

Box 8 - An example of the business case for energy efficiency measures

A Civil and Structural Engineering Consultants with a single floor office in St Helier implemented the following energy efficiency measures:

Encouraging good practice among staff - switching off computers and lights

Installation of an Owl Energy monitor in reception - monitor energy use and demonstrate the business's commitment to the environment

Replacement of original lights with LED lights

Results:

- 22% saving on the electricity bill
- This saving equates to at least £700 a year - the equivalent of a typical summer quarter electricity bill for the company
- Staff reported a better level and type of light - this resulted in a more comfortable working environment

(Eco Active, 2016a)

7.3 Potential Barriers

There are several reasons why energy efficiency improvements may not be implemented and it is important to recognise these and identify steps to overcome these challenges. Two of the most significant barriers are 1) an economic preference for short term economic gain and 2) consumer behaviour and knowledge. For the first point, initial investment in energy efficiency measures has potentially high costs with payback occurring over a number of years through economic and health benefits (Pollitt, et al., 2014, Jensen, et al., 2013).

There is therefore a need for policy makers and individuals to invest in decisions that may be costly in the short term to gain the long-term benefits from improved health, energy savings and GDP per capita growth (Jensen, et al., 2013). For rented accommodation, there is an additional challenge surrounding who receives the benefits of investment. The landlord makes the investment in energy efficiency improvements however the economic and health benefits are gained by the tenant. It is therefore vital that these barriers are removed, either through financial incentives or by effectively communicating the long-term benefits.

For the second point, in terms of the knowledge and behaviour of consumers, home owners and businesses may not be aware of the multiple benefits that energy efficiency improvements can provide, or may not be able to relate these benefits to their personal situation. This highlights the need for targeted awareness raising which clearly demonstrates the benefits that can be gained. The Warm Front Programme in England demonstrated that human perception of policies is an important consideration. The scheme was run on a self-selection basis and up to 60% of fuel poor households did not take advantage of the scheme. Sovacool (2015) suggests two reasons; firstly, some households that were fuel poor did not consider themselves to be fuel poor, and

secondly, they did not want to admit they were fuel poor due to the stigma around looking for help. Therefore, effective energy efficiency policies will persuade people that taking up these measures will provide multiple benefits and will not impact on their social identity (Sovacool, 2015).

8 Renewable energy in the domestic sector

8.1 Mitigation and Adaptation Actions

Through the Pathway 2050 Energy Plan, Jersey aims to implement micro-renewables in the domestic sector and implement actions to assist the uptake of micro-generation. The States of Jersey plan to identify the interventions that are required to encourage a switch to micro-renewables (e.g. solar, ground-source, thermal) for space and water heating from 2030. It will also investigate the level of intervention needed to prompt a switch to micro-renewables for swimming pool heating. A skills assessment will be used to construct a program for training and up skilling local renewable energy installers (States of Jersey, 2014a). Funding for these actions were cut in the Medium Term Financial Plans. However, work proposed and done by the Energy Forum aims to investigate micro renewables, the costs and benefits, the role they play in the decarbonisation of the Jersey energy supply, and recommendations for implementation (Jersey Energy Forum, 2017).

A micro-generation energy system which includes a mixture of renewable energy source (e.g. wind and solar) has the potential to be highly efficient and reliable, achieving emissions savings of up to 60% (IEA, 2016). Jersey's plans to develop renewables, if successful, will improve Jersey's ability to maintain energy supply if two failures in the system were to occur, for example two sources of power are lost (interconnector and on-island generators) (IPA, 2013). The diverse generation mix will allow Jersey to maintain energy security and protect Jersey against shock caused by climate change.

To assist the uptake of micro-generation, the States of Jersey planned to develop a pilot study that demonstrates the potential of micro-renewable schemes at a community level. The outcomes were to be presented in 2020 and highlight the economic, environmental and social benefits to be gained from micro-generation. It would also investigate barriers to implementation, possible incentives, training requirements and impacts to local energy security (States of Jersey, 2014a). As mentioned above, the funding for this has been removed, however this pilot study could have provided valuable insights into potential wider impacts of micro-renewable schemes in Jersey.

8.2 Wider Impacts

Table 8 - Overview of the strength and direction of wider impacts arising from policies to encourage renewable energy in the domestic sector

Future Jersey Outcomes	Climate Action: Renewables in the domestic sector
Sustainable Resources	++
Affordable Living	+
Jobs and Growth	+

Environment: Sustainable Resources

Locally generated renewable electricity could increase Jersey's energy security and leave the island less vulnerable to shocks in fuel price or a loss of supply (Komerath, et al., 2009, IEA, 2016, Cross, et al., 2016, Kuang, et al., 2016). This could be achieved through combining investment in micro-renewables, especially for heating, with investment in battery storage technology. This would reduce the need to supplement energy supply with on-island generation during peak periods, reduce exposure to peak prices from the interconnector to France, would supply energy were the interconnector to fail and could negate the variability of renewable energy sources (Cross, et al., 2016, Juang, et al., 2016). The initial investment in micro-renewables can be costly and the payback time depends on the system efficiency and funding options available to the buyer. However economic savings of up to 30% can be made by reducing the need to buy energy. These savings can be expected to increase whilst the initial investment costs will decrease as market penetration of micro-renewable technologies increases (IEA, 2016).

Economy: Affordable Living

The roll out of micro-renewables in homes in Jersey could bring down the cost of living for households, particularly benefiting those who are fuel poor. Houses would have the capability of generating all, or a portion of their own electricity, thus decreasing the amount of the household income being spent on energy (Komerath, et al., 2009). As with energy efficiency measures, the energy demand reduction can free up household income to spend on other commodities, making a decent standard of living more affordable. However, initial investment costs are high and, if this is a barrier to uptake, appropriate interventions may need to be considered to overcome this.

There is possibility for the rebound effect where potential economic benefits are not as great as anticipated. For energy efficiency measures, this could be where financial savings are spent on increasing the temperature of homes or other commodities. Despite reduced economic benefits, this could have significant well-being impacts if it is reducing exposure to cold environments and improving the quality of life of the inhabitant.

Renewables do require space, a potential conflict that needs to be recognised. Wind and solar both require space and this can have a negative impact on the landscape (Smith, et al., 2015). To some, there is a perception that renewable energy installations are visually intrusive and this can impact on their feelings about the landscape. Over time, increased uptake of micro-renewables may help to overcome this barrier as the focus shifts from the cosmetic issues to the environmental and economic benefits that can be gained (Komerath, et al., 2009). To achieve economic benefits of micro-renewables, there needs to be a consideration of standby charges. These need to be low enough to ensure that micro renewables are economically preferential.

Economic: Jobs and Growth

Jersey's future competitiveness relies upon economic confidence and demonstrated resilience to climate change. The Island's ability to deliver high levels of resilience to climate change could bring security for future investment and the provision of renewables is one way to demonstrate this resilience (Ellis & Smith, 2015). The increasing uptake of micro-renewables could stimulate new investment from a cohort that wouldn't normally invest heavily in the renewables sector. Since, investors may prefer to invest in local, individual owned projects as opposed to large schemes where

they don't have much influence, bringing inward investment to Jersey (Komerath, et al., 2009). An increasing interest in renewables could also attract increased private sector funding (Komerath, et al., 2009).

Economic benefits could also come through job creation (Komerath, et al., 2009, Pollitt, et al., 2014). An increasing demand for micro-renewables stimulates job creation in the low carbon sector. These could be local to Jersey as there is a need for installation and ongoing maintenance of micro-renewable technologies. There is also an induced economic impact as higher incomes (stimulated by job creation) will lead to higher demand as more can afford the initial investment costs. In turn, this creates increased outputs and employment in the low-carbon technology supply chain (Pollitt, et al., 2014).

8.3 Potential barriers

The barriers to uptake of renewables can be grouped into three categories; technical, economic and social. Technical barriers largely consist of the lack of supporting infrastructure such as inappropriate installation facilities, unsuitable transmission systems and difficulties in integrating renewables into the grid (Allen, et al., 2008, Blechinger, et al., 2016). These barriers could be overcome through investment in the supporting infrastructure by the States of Jersey.

Economic barriers include the high initial investment costs and small market size (Blechinger, et al., 2016, IEA, 2016). Reduced initial costs and faster payback times are needed to make micro-renewable systems the preferred options. However, this is also heavily influenced by the price of electricity and provision of appropriate incentives (IEA, 2016).

Social barriers to the uptake of micro-renewables exist because of a lack of awareness and knowledge among households. This could be down to many reasons including: a lack of initiatives surrounding renewables, the lack of a local champion or the focus on the visual impact of installations (Blechinger, et al., 2016, Smith, et al., 2015). This barrier can be reduced through the provision of targeted, useful information on the multiple benefits of micro-renewables (Allen, et al., 2008). This information needs to be easy to understand, relatable to a person's individual situation and independent.

9 Sustainable Agriculture

9.1 Mitigation and Adaptation Actions

Jersey aims to reduce emissions from ruminants (e.g. cows) by 30% by 2030 and will achieve this through changes to animal diet and husbandry techniques and genetic improvement leading to increased productivity (States of Jersey, 2014a). It also aims to implement anaerobic digestion systems for the management of livestock slurry by 2020. This target is supported by several other schemes and strategies. There will be an investigation of the potential use of the Countryside Renewal Scheme and Rural Initiative Scheme to encourage the implementation of anaerobic digestion for better management of livestock wastes. The Solid Waste Strategy will also explore whether anaerobic digestion can be used to process commercial and domestic food waste (States of Jersey, 2014a).

Agriculture that considers the future threats posed by climate change allows the sector to adapt to these challenges and manage the risks. Jersey hopes to enhance the productivity of agriculture whilst also ensuring sustainability and this will require the emissions per unit of output to be lowered. Adapting to climate change also involves greater sharing of information between stakeholders, greater consideration of risk and increased knowledge (Campbell, et al., 2014). The Rural Economy Strategy 2017-2021 outlines measures to promote these actions. Jersey aims to find alternative crops that are high value and more environmentally friendly and this can also contribute to climate change adaptation as varieties that are resistant to heat, drought, flooding and can be favoured. Combined with nutrient management and increased collaborative knowledge, resilience to climate change can be enhanced (Campbell, et al., 2014).

The Rural Economy Strategy outlines a plan for the years 2017 to 2021 for how Jersey's agriculture will adapt to the challenges of climate change whilst remaining economically sustainable and profitable (States of Jersey, 2017d). Between 2017 and 2021, the Rural Economy Strategy aims to implement the following actions which aim to enhance productivity, collaboration and sustainability:

- Encourage all farms to be "export ready". This will be encouraged through the provision and maintenance of key infrastructure; provision of abattoirs and the removal of barriers to productivity. This will be supported through a new Enterprise Strategy.
- Investment in research and development to identify crops with high value but reduced environmental impact. It is hoped that this will also break pest lifecycles.
- Targeted professional advice to encourage skill development in the agriculture sector.
- Protect the agricultural land bank and promote collaboration throughout the food chain through initiatives such as Farm Jersey.
- Introduction of the Rural Support Scheme to incentivise sustainability (economic and environmental) through precision farming, business coaching and training.

The Water Management Plan also contributes to future sustainable agriculture as it identifies the impact of pesticides on water quality as a key issue to be addressed in the next five years (Roberts & Neale, 2016). This plan encompasses the recommendations of the Nitrate Working Group including: informing and encouraging the use of good

practice, nutrient planning and management, precision fertiliser application and organic manure storage (Roberts & Neale, 2016).

9.2 Wider Impacts

Table 9 - Overview of the strength and direction of wider impacts arising from sustainable agriculture policies

Future Jersey Outcomes	Climate Action: Sustainable agriculture
Health and Wellbeing	+
Built and Historic	+
Natural Environment	++
Sustainable Resources	++
Jobs and Growth	+

Community: Health and Wellbeing

The use of fertiliser can have negative impacts on health through pollution of the water supply and emissions to air of nitrogen oxides and ammonia. Nitrous oxide is a major ozone-depleting substance, which is associated with increases in incidence of skin cancer (Smith, et al., 2015). A reduction in ozone-depleting substances through precision fertiliser application, for example, could have positive health impacts. Ammonia also has harmful health impacts with additional negative impacts for crops and ecosystems (Smith, et al., 2015). Ammonia can also contribute to the formation of secondary particulate matter, which can be a significant contributor to background pollution levels across Europe due to its transboundary nature.

There are also health benefits to be gained through increased food security and the nutritional benefits of locally sourced fruit and vegetables. Increasing productivity of agricultural land, whilst also increasing resilience to climate change will protect against the uncertainty in food supply caused by climate change; changes to what can grow and growing seasons. In considering the environmental impact of diets two elements are particularly important: the production system used and how the food is transported (Macdiarmid, 2014). Therefore, locally sourced food produced using sustainable agricultural practices could have a positive impact. This does, however depend on the crop being grown, which needs to be suitable to the local climate to ensure energy and resource efficiency. Consideration must also be given to addressing high red meat consumption and over consumption as these have negative environmental and health impacts. Compared to other food sources, the production process for red meat results in high GHG emissions (Lake, et al., 2012, Macdiarmid, 2014).

The maintenance of green spaces, achieved through sustainable agriculture has physical and mental health benefits. Green spaces act as a natural defence to storms and flooding, protecting nearby communities. Green spaces are more capable of absorbing flood water than urban landscapes and can retain more water. They can therefore help in reducing the flood risk in urban areas (Lennon, et al., 2014, Norbury, et al., 2017). There are also mental health benefits from being outdoors in the natural environment. Easy access to large areas of green space is associated with lower levels of anxiety and

stress. It is also related to increased social cohesion, green space being a social environment and this has subsequent mental health benefits (Nutsford, et al., 2013, Ruijsbroek, et al., 2017).

Environment: Built and Historic

Agriculture is an important part of Jersey's culture and offers a sense of place to many Islanders. It also contributes to the community economically and socially (States of Jersey, 2017d). Equally, some parts of the landscape are of vital importance, in Jersey and internationally due to the habitats present and the high quality of the environment (States of Jersey, 2017d). Measures that address, promote and implement sustainable agriculture therefore act to meet both these interests. They allow for growth of the agriculture sector whilst also protecting the environment.

Environment: Natural Environment

Reductions in ammonia, methane, nitrogen oxides and hydrogen sulphide can be achieved through anaerobic digestion of farm waste. This leads to improvements in air and water quality as well as a reduction in odour (Smith, et al., 2015) . All these elements contribute to the maintenance of a pleasant natural environment and healthy ecosystems. In addition, the by-products of anaerobic digestion can be used as environmentally friendly alternatives to farming processes. Biogas can replace fossil fuels for certain energy applications, and digestate can be used as a fertiliser. This is more economical as it reduces waste and expenditure of fossil fuels and fertiliser whilst also providing the environmental benefits of reduced greenhouse gas production (Smith, et al., 2015, Vaneeckhaute, et al., 2013). One area of caution originates from the aesthetics of anaerobic digestion plants. These could be viewed as visually intrusive if located near populations or in areas where natural beauty is highly valued. Careful planning and design is therefore vital to avoid this potential negative impact.

Environment: Sustainable Resources

Fertiliser run off contributes to the pollution of water and is a major source of phosphate and nitrate pollution. These chemicals cause eutrophication and acidification of water bodies with associated losses in biodiversity (Smith, et al., 2015). Precision fertiliser application, good practice, use of digestate and other measures to reduce fertiliser use therefore have benefits for reduced water pollution and reduced biodiversity loss.

Economic: Jobs and Growth

Gross Value Added (GVA) performance in the agriculture sector declined following the economic crisis and, despite recent recovery, remains below 2006 to 2010 levels. The sector relies heavily on subsidies and between 2011 and 2015 employment in the sector fell by 22% (States of Jersey, 2017d). However, several measures that address sustainable agriculture also have economic benefits. For example, the use of digestate as fertiliser eliminates the need to buy additional fertiliser whilst precision farming reduces fertiliser use and can increase productivity with economic benefits (Smith, et al., 2015, Snyder, et al., 2014). The potential increase in agricultural production from sustainable practices can also provide farmers with assets that can be utilised in times of stress which may become more frequent under climate change. It also provides them with the option to explore other pathways for development and income should the need arise (Campbell, et al., 2014).

The processing of digestate through anaerobic digestion produces many derivatives, some of which have the potential to be used as fertiliser (Vaneeckhaute, et al., 2013, Nkoa, 2013). Most of these digestates in solid form comply with European requirements for organic matter. The liquid digestate fertiliser value is not as high as undigested manure and slurry, but has a fertiliser value higher than that of inorganic fertiliser (Nkoa, 2013). This reduces the need to buy inorganic fertilisers and reduces waste from farming practices having economic benefit for farming businesses. Similarly, fertiliser use can be reduced through precision farming. This also has the potential to increase productivity as fertiliser is focused where it is most needed and at the optimal amount. Management of livestock diets can also increase efficiency in nitrogen use, reducing nitrogen loss and increasing profits (Snyder, et al., 2014).

9.3 Potential Barriers

Persuading farmers to change techniques, which are often rooted in tradition or family heritage, can be difficult due to an unwillingness to change or a lack of trust in new practices. Likewise, any changes to practices that may be proposed would need to have proven economic or efficiency benefits. Farmers are often reluctant to take a risk, especially given the high risk already posed by the uncertain impacts of climate change on growing seasons and crop production. Education and stakeholder engagement are therefore crucial to understand the priorities of different farmers. Barriers may be situation dependent and even specific to an individual farm and therefore local studies are needed to discover the local barriers.

10 Adapting to sea level rise and extreme weather events

10.1 Adaption plans

Sea level rise, in combination with increased incidence of storm surges is an increasing threat to Jersey and adaptation to the consequences is a key priority. This has led to the creation and implementation of the Integrated Coastal Zone Management Strategy and the Sea Defence Strategy. The Integrated Coastal Zone Management Strategy (ICZM) is the overarching plan for the implementation of policies and practices that promote an integrated approach to coastal management involving multiple stakeholders and addressing the entire coastal zone (States of Jersey, 2008). The policies included under the ICZM Strategy address four key areas:

- Protect and conserve – the strategy aims to protect the heritage of the Jersey coastline, support wildlife and habitats, and support ecological resilience.
- Increase understanding of marine and coastal environments and the impact that human activities can have on them. This includes measures to minimise adverse impacts and improve decision making.
- Promote the sensitive use of natural resources to ensure benefits are gained in the long-term (economic, environmental and social).
- Engage with stakeholders to increase understanding and awareness of the value of marine and coastal environments. This area aims to increase involvement in adaptation activities (States of Jersey, 2008).

Climate change induced sea level rise is one of the most pressing environmental issues for Jersey and the Integrated Coastal Zone Management strategy allows for a joined up, efficient response. A reliance on the natural environment for the way of life mean that adaptation is crucial (Petzold, 2017). A strategy that has in-built flexibility is the most effective in adapting to climate change as it allows for changes in scientific evidence, changes in societal attitudes towards risk and the large uncertainties associated with sea level rise and tidal surges (Wilby & Dessai, 2010). The interaction between stakeholders, consideration of wider environmental and social networks, and integration of management strategies through an Integrated Coastal Zone Management strategy allows for this degree of flexibility and to maximise environmental, economic and social benefits.

The Sea Defence Strategy is an adaptation plan that aims to increase the climate resilience of Jersey (i.e. improve the Island's ability to manage the impacts of sea level rise and increased frequency of storm surges). First initiated in 2001, this plan has implemented projects to improve Jersey coastal defences including the construction, replacement and maintenance of sea walls as well as studies of the marine environment and risks to the population (States of Jersey, 2015b). Future actions planned under this strategy include:

- An economic assessment of the impacts of climate change on Jersey
- Structural changes to sea defences including the heightening of sea walls and secondary defences to accommodate climate change impacts
- A flood risk assessment for St Helier that integrates climate resilience and adaptation into decision making and planning processes

- Ongoing maintenance and repair of existing key sea defences. Prioritisation for action will be based on current performance, risk to people and property and sensitivity to climate change impacts (States of Jersey, 2015b).

10.2 Wider impacts

Table 10 – Overview of the strength and direction of wider impacts arising from policies that address adaptation to sea level rise and extreme weather events

Future Jersey Outcomes	Climate Action: Adapting to sea level rise and extreme weather events
Safety and Security	++
Health and Wellbeing	++
Built and Historic	++
Natural Environment	+
Attractive Business Environment	+

Community: Safety and Security and Health and Wellbeing

Due to both population increase and sea level rise, the number of people exposed to the threat of flooding increases. Therefore, adaptation is required to reduce the number of people exposed to this risk (Bosello, et al., 2012, Hinkel, et al., 2010). Health and safety are protected through adaptation as key health care services are at less risk of flooding. Several health care services, including Jersey General Hospital are situated near the coast and therefore this adaptation is essential to reduce flood risk. The building of flood defences and integrated coastal management can help in improving the resilience of these services, ensuring that they can remain in operation (Healthcare System Adaptation Report Working Group, 2015).

At the individual level, flooding can have serious impacts on mental health and wellbeing (Devine-Wright, 2013). This can be improved through social connectedness and the provision of green spaces which are both provided through integrated coastal zone management. Social connectedness enhances a community's ability to adapt and respond to sea level rise and flooding as vulnerable people have access to the help they need (Healthcare System Adaptation Report Working Group, 2015). For example, a survey of UK residents affected by flooding in two areas showed that 84% agreed or strongly agreed that flooding was easier to deal with if there was a sense of community spirit (Butler, et al., 2016). Green spaces and habitats meanwhile work as natural coastal defences but also mental and physical health benefits as more people spend time outside exercising (Healthcare System Adaptation Report Working Group, 2015).

There are associated economic benefits to reduced exposure to flooding as the cost of temporary or permanent displacement and repair following flooding is reduced (Bosello, et al., 2012). There are also wider economic and social benefits of increased understanding of flood risk among communities, individuals and organisations. Key stakeholders and individuals are more informed of risk and this leads to better decision making which takes risk into account.

Environment: Built and Historic

St Helier is especially vulnerable to the threat of sea level rise as it is on low lying land, has a high population density and is the economic, cultural and social centre of Jersey. Resilience to climate change is therefore crucial for residents and business (States of Jersey, 2015b). Economically, adaptation to sea level rise can protect St Helier from flooding with economic benefits from reduced cost of damage repair, land loss and displaced communities. These benefits are felt by business owners, residents and property owners (Bosello, et al., 2012, Penning-Rowsell & Pardoe, 2012). The protection of property not only has economic benefits but also social benefits. Property is a critical asset that many people depend on and therefore value very highly. As such, a key issue is the public perception of sea defences, the benefits of protection being peace of mind and reduction of worry for residents and businesses (Penning-Rowsell & Pardoe, 2012, Jones & Clark, 2014).

The protection of St Helier, for many, could contribute to the protection of a person's sense of place and place attachments. The natural, built and social environment that a person resides in contribute to the individual sense of identity. The place attachments that are under threat from sea level rise and flooding include: the sense of community from recreational activities (such as spending time in parks), the sense of belonging from family connections to local places and identities (both personal and communal) that are associated with coastal tourism and fishing (Graham, et al., 2013, O'Neill & Graham, 2016). Forced relocation, the loss of land or damage to property from flooding associated with sea level rise can cause the loss of traditional culture and hence the loss of a sense of place causing mental health problems. The protection of property and key landmarks through sea defences therefore has mental health benefits and increase community resilience (Devine-Wright, 2013). It can lead to a community that is more risk aware and therefore more supportive of adaptation activities.

There are many sites of historic, cultural and archaeological importance along the Jersey coastline, such as: La Cotte de St Brelade (a key Palaeolithic site in the British Isles); the remains of a Neolithic forest and peat beds held beneath the intertidal sands; and a number of fortifications ranging in age from Tudor to Second World War (States of Jersey, 2008). As relocation is not an option, sea defences and adaptation to sea level rise will help to protect these sites and ensure that they remain part of the Jersey culture. Defences slow the rate of land loss from erosion and submergence due to sea level rise enabling these sites to remain (Bosello, et al., 2012). This has economic and cultural benefits.

Economically, these sites may attract tourists and local visitors, bringing income to the area with direct and indirect benefits, such as investment in the area and in local businesses. Culturally and socially, the preservation of historic sites enables individuals to maintain a sense of belonging. Sense of place and belonging are often tied to a person's values which are influenced by heritage, tradition and a sense of closeness to others. Adaptation to sea level rise therefore has multiple cultural benefits through: the protection of a sense of belonging; and maintenance of a person's ability to visit cultural sites (Graham, et al., 2013). As previously outlined, the mental health benefits from a protected sense of place and belonging are significant.

Environment: Natural Environment

The Jersey marine environment contains many ecosystems of importance to Jersey and internationally including; offshore reefs, intertidal sands and wetlands. These habitats

are at threat from sea level rise due to erosion, salinization and/or an increased probability of submergence or inundation (Bosello, et al., 2012). These ecosystems are not just essential for marine species, the marine environment is often considered an essential part of an island's identity (Petzold, 2017). It is an important resource for tourism, recreation and education (Firth, et al., 2014) providing economic opportunities and health benefits as people spend a larger proportion of their time outdoors.

Whilst hard defences of any nature will have an impact on coastal habitats, it is possible to make these changes beneficial to the marine environment through a consideration of ecosystems. Jersey can achieve this through the Integrated Coastal Zone Management strategy with benefits for biodiversity and the provision of natural resources. For example, hard defences can be engineered to include rock pools and crevices, providing heterogeneity in the habitat and allowing new species to colonise these areas (Chapman & Underwood, 2011, Firth, et al., 2014). New structures can also be engineered to mimic local natural environments to support current biodiversity and allow native species to thrive (Firth, et al., 2014). This can be done through the use of local materials thus providing not only biodiversity benefits but also local economic benefits. Managed retreat is also an option for reducing flood risk and protecting natural habitats, as implemented as St Ouen's Bay.

Economic: Attractive Business Environment

Erosion of beaches causes economic losses from the loss of land and reduced tourism. However, the most significant monetary losses arise during extreme weather events caused by the combination of sea level rise, storm surges and high tides (Bosello, et al., 2012, Hinkel, et al., 2010). Protection against these events therefore brings associated economic benefits in the form of;

- Retained or increased income per capita from tourism
- Affordable land prices as market rent of coastal land remains lower
- Increased profit for businesses as production costs on coastal land are lower due to decreased risk and associated insurance costs
- Protection from damage for businesses near the coasts (Bosello, et al., 2012, Hinkel, et al., 2010, Philips & Jones, 2006).

Increasing GDP and growing land values as St Helier develops means that adaptation to sea level rise is increasingly cost-effective. Integrated Coastal Zone Management allows for the maximisation of economic benefits whilst also considering the natural environment (Hinkel, et al., 2010, Philips & Jones, 2006).

Adaptation to sea level rise can also be associated with job creation and inward investment. It provides safety for businesses and developers looking to invest which enables growth, development and inward investment (Penning-Rowsell & Pardoe, 2012). Likewise, these measures could help existing, local businesses to thrive. For example, protection of the harbour allows for the development of the fishing, tourism and associated businesses (Penning-Rowsell & Pardoe, 2012). There are also potential business opportunities in the development of marine renewables. Jersey has a large tidal range therefore the exploitation of this as an energy source could lead to job creation and additional income, but it needs to be designed with due consideration of the marine ecosystem. Compared to solar and wind, marine renewables do not pose such a risk of conflicting space requirements.

10.3 Potential Barriers

The cost of infrastructure projects and a lack of political will are often cited as significant barriers to adaptation to sea level rise. Climate change and sea level rise are perceived as a longer vulnerability and therefore political will and institutional capacity may be lower. Outside of Scotland, adaptation planning is not a statutory requirement for the UK and therefore it is at risk of resource and funding cuts. However, not adapting to sea level rise will have significant negative economic consequences (Porter, et al., 2015). This battle for resources can be exacerbated as the performance of adaptation measures are often not recorded or analysed and therefore the economic justification for action can be harder to prove (Porter, et al., 2015).

The lower priority of adaptation to sea level rise at higher institutional levels can trickle down to the local level and result in a lack of risk awareness and local leadership. The lack of a local leader can lead to the absence of this issue from decision-making and less awareness of the risks among communities. This does nothing to reduce the uncertainties and risks surrounding sea level rise that arise from a lack of awareness at all levels of decision-making (Eisenack, et al., 2014).

At a local, community level, social networks play an important role in how residents react to adaptation measures. However, these networks are complex and the many interactions can have contrasting and possibly conflicting impacts on the public acceptability of the measures and perceptions of adaptation (Jones & Clark, 2014). These networks also contribute to a person's sense of place which is often neglected in adaptation policies. Consideration of this can highlight the psychological and cultural aspects of a place and the risks that climate change poses to these aspects. It can also reveal where conflicts between action and communities may occur. A failure to take account of place attachment within a community can lead to resistance to adaptation action and a general lack of support for activities (Devine-Wright, 2013, O'Neill & Graham, 2016).

It is possible to overcome these barriers to a certain extent through the framing of adaptation and the use of social networks. By presenting climate adaptation as resilience to extreme weather events, it makes the issue more immediate and applicable to everyday life. It brings the focus onto the risks of climate change and offers immediate tangible benefits (Porter, et al., 2015). Similarly, engagement with and awareness of sea level rise issues can be enhanced through social networks as these are particularly effective for the rapid dissemination of information (Jones & Clark, 2014).

11 Behaviour change and communications

11.1 Mitigation and Adaptation Actions

Behaviour change is a cross cutting issue that impacts all sectors. Jersey aims to address behaviour change through both specific behaviour change actions and indirectly through other climate mitigation and adaptation actions. The States of Jersey specifically target energy efficiency, aiming to improve energy efficiency through a behaviour change programme. This was to be implemented using an awareness raising campaign, incorporated into other energy efficiency actions via the eco-active energy efficiency service however service is no longer provided (States of Jersey, 2014a). Behaviour change is also addressed in the Sustainable Transport Policy through its efforts to promote a modal shift away from private vehicles. It aims to make more environmentally friendly transport options the easier and preferred choice. One way in which this is being encouraged is through the Gigabit Jersey project which aims to improve internet accessibility, making it easier to work from home and not commute (States of Jersey, 2015c).

11.2 Wider Impacts

When considering the impacts of behaviour change policies it is important to recognise that there are internal and external variables in peoples' behaviour. Internal variables are the thoughts, knowledge, values and entrenched behaviours of an individual. External variables are the social and physical environment in which a person lives (Rae & Bradley, 2012). For behaviour change actions to be effective, education is key. Demand management is also important, for example, reducing the need to travel, reducing energy consumption and making more sustainable dietary choices. Demand reduction and education are closely linked and work together to promote behaviour change. Therefore, policies that target demand management should complement technical measures.

Table 11 - Overview of the strength and direction of wider impacts arising from behaviour change policies

Future Jersey Outcomes	Climate Action: Behaviour change and communications
Health and Wellbeing	++
Natural Environment	+
Affordable Living	++
Jobs and Growth	+

Community: Health and Wellbeing and Economy: Affordable Living

The benefits of behaviour change for an individual can be immediate for example; lower energy bills from switching off lights and reducing the temperature. All of the benefits that are achieved through measures to target energy efficiency can also be gained through behaviour change that results in lower fuel use (improved health, lower fuel poverty, improved air quality) (Smith, et al., 2015). Communicating the multiple benefits

of behaviour change is vital, as is the need to dispel the perception that energy efficiency means giving up life's luxuries. If done successfully, behaviour change can help stimulate a move to a more sustainable energy supply as demand decreases and uptake of micro-renewables increases (IEA, 2014, Rae & Bradley, 2012).

Environment: Natural Environment

Demand side management and behaviour change can increase the lifetime of existing technologies as there is increased utilisation of current energy generating capacity. For example, it can lead to better planning of resources to cover the intermittent nature of renewable energy supply. This improves the economic performance of energy generating technology over its lifetime, increases overall energy system efficiency and offers greater flexibility and robustness with minimised storage requirements (Kuang, et al., 2016, Rae & Bradley, 2012). This has benefits for Jersey's energy security; making it more sustainable and resilient to the threats of climate change. It also means that there is less requirement for new technologies that may compete with the natural environment for space.

Economic: Jobs and Growth

Behaviour change within businesses present an opportunity for cost savings with lower energy and resource use. There are also marketing opportunities as businesses can brand themselves as "sustainable". First movers in this field could be seen as innovative, filling a gap in the market with associated economic benefits. In Jersey, Radisson Blu is one company that is integrating environmental awareness into everyday business life.

Box 9: Radisson Blu Hotel Jersey. Integrating environmental awareness into business.

"Think Plane" is a Radisson initiative that aims to minimise the environmental impact of its hotels through the promotion of an environmental and energy conscious culture. This is one of three pillars of Responsible Business. Energy saving culture is encouraged through simple, comprehensive monitoring (daily checks of electricity, water and gas use).

Actions:

- Every hotel has a designated Responsible Business Coordinator
- All employees are given training on environmental and energy awareness
- All employees are given monthly environmental updates

Measures that have had the biggest impact:

- Building Management System optimisation
- Air handling unit maintenance
- Staff good habits
- LED lighting

Result:

- 17.7% decrease in energy use between 2008 and 2015

(Eco Active, 2016b)

11.3 Potential Barriers

Successful behaviour change campaigns (reducing drink driving, lowering rates of smoking) have targeted single actions with simple, easy to communicate message and tangible benefits. They have also benefitted from simple cost benefit messages and legally enforceable actions. Energy efficiency behaviour changes, however, are not so tangible and the benefits are more distant. The cost savings will not be seen until the next energy bill (Baker, 2017). It can also be hard to persuade people to take action in their homes when societal cues around them indicate something different, for example: lots of cars on the road, increasing air travel and public buildings that are lit up at night (Baker, 2017). Individuals need to be persuaded that it is worth taking action, that there are immediate and tangible benefits to doing so. One possible solution is for behaviour change and policy to work in tandem, policy providing the push that initiates behaviour change. Behaviour is shaped by the environment we live, work and grow in and this includes the policy environment. There may also be a role for charities as drivers of change. Their potential lies in their ability to spread information and implement action at a fast rate and the ability to target specific hooks (such as air quality or children's health). An assessment of the wider impacts of climate action, as provided by this report, can help in identifying and targeting these hooks.

12 Research and knowledge gaps

A deeper understanding of the social context is advantageous in creating policies that are most effective. There are some gaps in this understanding that have been identified during the course of the work for this report. For example, a greater understanding of fuel poverty levels in Jersey would allow for a better assessment of the potential wider impacts of energy efficiency measures. Social studies would also help to understand the level of engagement and understanding among the public: is climate change generally accepted, do people see it as an important issue? In turn this will help to understand the different hooks for behaviour change: what is important to people, how can the messages be tailored to be most effective?

A greater evaluation of risk from climate change across all sectors and levels would also be beneficial in understanding the potential impacts on Jersey. For example, what will be the risk for businesses or individuals? A consideration of all possible eventualities will help to mitigate some of the uncertainties that climate change brings and will help to focus decision making on the immediate concerns. With limited resources, prioritisation is needed. This can be achieved through consideration of risk combined with an assessment of wider impacts. Cross sector and stakeholder engagement will lead to joined up, efficient decision making.

Analysis of possible barriers and solutions to overcome these barriers will help to push climate action forward. For example, an assessment of why action hasn't happened in the past could reduce the likelihood of the same barriers reoccurring. These barriers are likely to be specific to Jersey and linked to the social context mentioned above. A collaborative effort is needed to overcome these barriers.

13 Barriers and solutions

Throughout this report, potential barriers to climate actions have been highlighted. These barriers affect the extent to which beneficial wider impacts can be achieved. It is therefore necessary to analyse these barriers and the possible solutions. The barriers and solutions presented below are high level and cross-cutting, affecting all of the climate actions outlined above. It is important that these barriers are overcome to make the implementation of climate actions and the maximisation of wider benefits effective.

13.1 Translating States of Jersey targets with clear and consistent messages

Barrier: A breakdown in communication can sometimes occur when translating Jersey targets into local actions, for example the local implementation of the target to reduce emissions in Jersey by 80% by 2050. Inconsistencies can arise when local parishes do not fully understand how the headline target is translated to local action, what it means for them and who is responsible for implementing the action (Bache, et al., 2015, Tompkin, et al., 2010). It can also arise when local areas implement action in contrasting ways. There is a need for clear, consistent messaging with more comprehensive evaluation of evidence and impact. The approach to performance monitoring needs to be consistent across policies and sectors.

Solution: Regular communication in terms that are understood by local actors and links government and local priorities is needed. A consistent and comprehensive approach to performance monitoring, potentially through indicators for climate actions and wider impacts, could lead to informed decision making and a joined-up approach across private and public sectors. Evaluation of impacts and the release of this information through clear, easy to understand messages would help to encourage public engagement and allow for the identification of effective policies. There is a significant opportunity for the States to act as an agent for change. With 6,000 employees and families, there is big potential to contribute to discussions around change. Further communication of good news stories and actions being taken by States of Jersey employees could help increase public engagement and encourage others to act. Consideration needs to be given to the most appropriate means of disseminating this information.

13.2 Political will and funding for implementation of climate action

Barrier: In many local areas in the UK, political will and funding can also be a barrier to the implementation of climate change actions. Climate change is often seen as distant threat, in contrast to travel disruption, health emergencies or extreme weather that are seen as more immediate threats. Combined with the economic downturn, this pushes climate change action down the priority list, leading to a lower share of resources (Porter, et al., 2015). A lack of willingness to implement effective climate change policies can also be related to lack of information and incentives (Bache, et al., 2015, Tompkins, et al., 2010, Moser & Ekstrom, 2010). Barriers can occur when this information is poorly communicated or misunderstood (Moser & Ekstrom, 2010). In Jersey, as with the UK, the four-year political cycle means that there is an expectation of quick and proven results within three years. However, many climate actions are hard to measure and this can lead to a lack of political appetite to address this issue and a lack of long-term thinking. There is also a perception that public appetite for action in this area is not as high. There is a fear of the unknown and a cost of exploring options which can cause inaction.

Solution: The engagement of policy-makers and stakeholders and awareness and understanding among the public are vital for effective implementation of policy. This includes information concerning the problem, how it can be solved, the implications and the benefits to other areas of the economy. Studies of the wider impacts of climate change policy can help in overcoming this barrier as they highlight the potential synergies between environmental, economic and social goals. It also provides decision makers with an idea on which policies have win-win impacts and are therefore most efficient for addressing multiple targets. There is an opportunity for Jersey to be a leader in small nation and island solutions and this could bring investment and economic opportunities to the island. It would also provide solution that are tailored specifically to Jersey. There are economic opportunities that could open up because of climate change. For example, with a sizeable baking and agricultural community, Jersey could be well placed to engage in carbon trading activities.

13.3 Public understanding, beliefs and behaviours

Barrier: Climate change is a complex, global issue which can be hard to understand. Jersey is a small country and this can lead to individuals questioning what impact they can really have. It can be hard to translate the impacts of climate change to an individual's situation leading to confusion over when and how to act. Even with the provision of additional information, a barrier may still exist relating to people's values and beliefs. These are deeply held and influence a person's perception of risk and what information they value the most (Moser & Ekstrom, 2010). These values are built up over time through experiences, knowledge and tradition and often inform decisions on new situations.

Solution: Further investigation and social science research into the influence of deeply held values is needed to understand individual interactions with climate change policy. It is important to understand the individual hooks, for example; reduced risks, improved health, increased house prices, as these can enable effective, targeted action. An understanding of wider benefits, beyond the mitigation of climate change, can help in encouraging a willingness to change among the public.

14 Conclusions and Recommendations

The magnitude and impact of climate change and the successful technologies and resilience strategies will continue to evolve. (e.g. alternative fuels, negative emissions technology, resilient buildings). These uncertainties pose a risk but also provide opportunities. There is a need to act now and implement appropriate changes that work with the technology and situation (socially, politically and environmentally) that is currently in place. Future improvements in understanding, including through learning from actions, will allow these actions to be further refined and improved with time.

This report has set out the wider impacts of climate change action and has related these to the Future Jersey outcomes. Considering the wider impacts (synergies and conflicts) allows policy makers to make good decisions and allows resources to be allocated efficiently. It encourages decisions to be made across government departments and stakeholders, helping to maximise the potential benefits and minimise potential negative impacts. For action to be implemented effectively, there needs to be a recognition of the barriers that are specific to Jersey. These barriers impact the magnitude of wider impacts that can be experienced and require targeted action to be overcome. The first step to overcoming these barriers is to assess the possible solutions. A consideration of climate change and climate actions needs to be embedded into wider government strategies as a way of bringing together community, environmental and economic goals.

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Appendix 1

Methodology

To complete this study, the following activities were undertaken:

- Review of Jersey key documents including mitigation and adaptation strategies and plans
- Extraction of relevant literature from the Aether co-benefits and wider impacts database
- Literature review to identify further literature and sources that are specific to the Jersey context
- Workshop with a range of public and private sector stakeholders

The evidence collected from the literature review and workshop was analysed and the key relationships between mitigation and adaptation actions and wider impacts were mapped out. The key findings were synthesised with cross-cutting themes, key conclusions and recommendations being drawn out. The key findings were presented in the context of the Future Jersey outcomes.

Literature review

The literature review aimed to identify both academic and grey literature sources that contained information on wider impacts of climate action relevant to the Jersey context. Aether used sources such as Google Scholar, journal databases such as ScienceDirect and ResearchGate, institute websites and the States of Jersey website to gather this information. Searches were conducted using key words. These key words considered variation in terms used for wider impacts including 'co-benefits', 'ancillary benefits', 'conflicts' and 'trade offs'. It also searched beyond 'wider impacts' as some evidence talked about the specific impacts such as 'air quality' or 'fuel poverty'. Additional relevant literature and datasets were also identified at the stakeholder workshop.

Workshop

On the 16th October 2017, the States of Jersey Department of the Environment and Aether held a workshop to contribute to research currently being undertaken. Workshop participants had a range of cross-sectoral expertise and were a mix of private and government stakeholders. There were 21 stakeholders present. Aether provided presentations on the context to the study and its initial findings, followed by two breakout sessions. The first session focused on the initial outcomes of the study (outlined in the draft report “Wider impacts of climate change mitigation and adaptation actions in Jersey”). Participants were asked to comment, using post-it notes, on the wider impacts identified, including strength and direction of impact, and identify further evidence, in particular, of relevance to the Jersey context. The second session saw the participants split into three groups to discuss: Jersey specific barriers to the implementation of climate change actions; how these barriers could be overcome and how these barriers can be accounted for in policy making. The outcomes from the workshop were fed into the final report.

Workshop Agenda

	Agenda item	Approach
11.00-11.30	Registration	Registration and coffee
11.30-11.40	Format of the day	Presentation (Jersey Department of Environment and Aether) Welcome: introduction to aims of workshop, schedule, and general housekeeping
11.40-12.00	Welcome and come together	Introductions Round the table one minute introductions: opportunity for each participant to sum up their role
12.00-12.10	Context to and purpose of the project	Presentation Welcome by Jersey: how the results will be used to inform policy. Setting of the project into the context of My Jersey Goals
12.10-12.30	Overview of findings	Preliminary findings of the initial research Brief presentation of review outcomes on the evidence (short background paper will be sent out ahead of workshop).
12.30-13.15	Research findings	Gain the individual perspective of participants Poster presentation by Aether of: 1. Summary table of magnitude of main co-benefits and adverse side-effects for different mitigation actions. 2. Research by themes and co-benefits, Participants will have 30 minutes to evaluate and comment on the preliminary findings, and identify further research themes and data sources. Post-its will be used to capture thoughts. The last fifteen minutes of the session will involve facilitator-led discussions around selected comments and ratings.
13.15-14.00	Lunch	
14.00-14.45	Barriers to integration	Participants in set groups will discuss barriers to achieving co-benefits in practice, e.g. through lack of co-ordination between institutions, and means of overcoming these barriers. The groups will be facilitated. Groups will report back at 14.30.
14.45-15.15	Recommendations	Individual contributions Round table contributions from each participant to capture their suggestions for next steps?
15.15-15.30	Wrap up and outlook	Presentation Summing up, next steps and thanks from Aether and Jersey.

Workshop Discussion Questions

The second breakout session aimed to explore the Jersey specific barriers to the implementation of climate actions. To achieve this, the following questions were used to guide discussion:

- What are the key barriers to achieving climate change action and beneficial wider impacts in your sector and more broadly in the Jersey context?
- How could these barriers by overcome in the short and longer term?
- How could these barriers be accounted for in policy making?

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