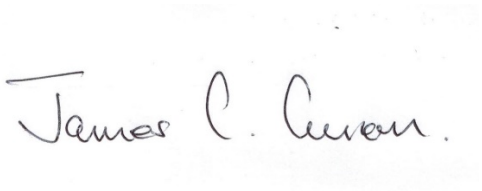
IMPACT

Isle of Man Programme for Achievement of Climate Targets

An independent report on options for targets and actions to achieve net-zero emissions by 2050

Submitted to the Isle of Man Government



James C Curran

31 October 2019

GD 2019/0102

Climate Change Action Plan 2020 to 2050

"Change will not come if we wait for some other person, or if we wait for some other time. We are the ones we've been waiting for. We are the change that we seek."

Barack Obama

Foreword and Summary

I have been privileged to act as the independent chair of the Climate Change Emergency Transformation Team. I have been received on the Isle of Man with memorable support, enthusiasm, and, as far as I can judge, overwhelming positivity for what I have tried to do.

I want to record my wholehearted appreciation of all those, particularly members of the Transformation Team and the Analytical Team, who have been closely involved in creating this proposed action plan. They have worked well beyond what might be expected.

However, at the end of the day, I take full responsibility for the content of this report. In the spirit with which this endeavour was undertaken, I am very well aware of its shortcomings and accept there will be some errors. The Team and myself continue to seek out challenge and inspiration to improve it further.

In summary, this report, underpinned by a valuable collection of evidence in the Appendices, recommends a higher ambition pathway for the Isle of Man to play its full part - joining other developed nations around the world - in addressing the increasing dangers of climate change. A timetable of actions is laid out, in some detail over the first 3 years to 2023, with reasonable certainty to 2030, but more indicatively between 2030 and 2050, as decisions in later years will be influenced by changing expectations and technologies. The cost of the recommended pathway is estimated in terms of both public and private sector investment.

The report makes clear that, essential to delivery, will be robust governance, wide public support, and leadership at all levels of civic society.

The transition to net-zero may not be easy, but it can be done, and there will be many co-benefits: creating a respected, healthier, more successful, resilient and future-proofed nation.

James Curran, 31 October 2019

Index of IoM climate change report and action plan

Executive Summaries and Appendices (links)

1. Task

The task that was set in May 2019, and laid out in the Terms of Reference (Appendix 1), was to prepare a climate change action plan for the Isle of Man to achieve net-zero climate emissions by 2050. The Chief Minister stated that the Government recognised the climate emergency facing the planet, and was committed to acting: "We are not about words, we are about the actions that we take and we will work with Tynwald members, the public and interested groups to put in place a comprehensive action plan to reach this achievable target."

Reinforcing the Chief Minister's statement, in June 2019, Tynwald also recognised the climate change emergency and committed to immediate action and called "on the Council of Ministers to set up a dedicated climate emergency transformation team, led by an independent Chair with relevant expertise, to develop the climate change action plan to include ambitious target options for achieving net zero emissions with interim targets and a climate impact assessment of proposals; in order to inform any statutory target obligations included in the proposed Climate Change Bill being introduced in the next legislative year; and calls upon the Government to lay its Climate Change Action Plan before Tynwald by January 2020."

The independent Chair, whose report this is, was recruited in early July 2019 and an internal Analytical Team was brought together, from across Government departments, at the start of August 2019.

2. Context

2.1 Scientific Background

The Irish experimental scientist John Tyndall is often credited with being the originator of the science of climate change. Building on work by others, he certainly demonstrated that carbon dioxide (CO_2), water vapour and methane (CH_4) gases all absorb heat from solar radiation, explaining why the Earth remains warm and able to support life.

But it was Arrhenius, a Swedish scientist, who calculated in 1896 that increases in atmospheric carbon dioxide could drive global temperature increases.

Interestingly, around 1917, the inventor Alexander Graham Bell is quoted as saying “I am inclined to think we would have some kind of greenhouse effect. ... The net result is that the greenhouse becomes a hot-house.” Bell also promoted tidal and wave power, "which we have not yet learned to utilise", and "the employment of the Sun's rays directly as a source of power".

In the mid-1930s it was the Englishman, Guy Callendar, who compiled historical air temperature measurements and related them to an increase in atmospheric carbon dioxide.

However, it wasn’t until the 1960s that some scientists were warning that the effects on the future global climate could be radical. In 1965 a prestigious group of scientists had suggested, with noteworthy foresight, that "by the year 2000 the increase in atmospheric CO_2 ... may be sufficient to produce measurable and perhaps marked changes in climate."

Despite this long history, and the growing and overwhelming evidence of the Earth’s sensitivity to greenhouse gas emissions, climate change has remained rather controversial. Even today, doubters and sceptics still exist. But the scientific community, prominent world

leaders, and more recently, public activism have now convinced the majority of all sectors of society that action is needed. Nevertheless, a task remains to increase awareness of the scale and urgency of the societal changes that are needed.

As President Obama stated in 2014 at a UN climate summit: “There’s one issue that will define the contours of this century more dramatically than any other, and that is the urgent and growing threat of a changing climate.”

2.2 International Context: UNFCCC and IPCC

As a result of the growing concerns relating to climate change, the United Nations Framework Convention on Climate Change (UNFCCC) was set up in 1992. It has an agreement that the underpinning scientific work will be delivered by the Inter-Governmental Panel on Climate Change (IPCC), which is sponsored jointly by the World Meteorological Organisation and the UN Environment Programme. The IPCC brings together reputable climate scientists from across the world and regularly assesses all peer-reviewed studies in order to arrive at its conclusions. Their published reports, known as Assessment Reports (ARs), with the most recent published in 2014 https://www.ipcc.ch/report/ar5/syr/, are regarded as the most reliable and comprehensive source of predictions on climate change and its future impacts. These reports are heavily drawn upon in the regular UNFCCC Conferences of the Parties (CoPs) which are held annually and act as the supreme decision-making body. Some of these CoP sessions are very well known such as in Kyoto in 1997, Copenhagen in 2009, and Paris in 2015. The IPCC also sets the standards and methodologies for calculating and reporting on national greenhouse gas emissions.

The Paris Agreement (https://unfccc.int/sites/default/files/english_paris_agreement.pdf) commits all its 185 signatories to “holding the increase in the global average temperature to well below 2°C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5°C above pre-industrial levels, recognizing that this would significantly reduce the risks and impacts of climate change”. In response to this decision, the IPCC was commissioned to publish a report in 2018 on the requirements to meet the +1.5 ^{o}C threshold. It is recognised that there are rapidly increasing risks if global temperature increases beyond 1.5^{o}C above pre-industrial levels. Those risks include severe heatwaves, droughts, fluvial floods, sea-level rise, storms, mass movement of climate refugees, political instabilities, spread of pests and diseases, extinction of species and damage to ecosystem services, crossing of potential positive-feedback tipping points, and increasing costs of climate adaptation.

The IPCC report makes it clear that a final global temperature rise is a function of the emissions accumulated over preceding years. So, it is important that the accumulation is also limited, by reducing global emissions earlier rather than later, as well as establishing an end-point by which emissions are eliminated. For this reason, the IPCC report states that a 45% reduction in CO_2 emissions is required by 2030, while reaching net-zero in 2050 – in order to maintain a relatively safe future climate.

https://www.ipcc.ch/site/assets/uploads/sites/2/2019/05/SR15

2.3 National Commitments

It still remains relatively uncommon for nation-states to commit fully to such stretching reductions in emissions. So far https://www.climatechangenews.com/2019/06/14/countries-net-zero-climate-goal/ there are either agreements, policies or, in some cases laws, in place to deliver net-zero emissions by 2050 in France, Germany, UK, Portugal, Denmark and Ireland among a few others. Sweden has committed to a date of 2045, Finland to 2035 and Norway to 2030. The EU is currently considering whether to adopt a target date of 2050.

2.4 Ecological Emergency

It is increasingly recognised around the world that the planet is facing not only a climate emergency but also an ecological emergency. Development, and particularly growing impacts on land use through the demand for more and more resources, is seriously damaging habitats, ecosystems and species. WWF reports that across 16,700 populations of over 4,000 species of mammals, birds, reptiles, fish and amphibians, the global abundance has dropped 60% over the past 50 years.

https://s3.amazonaws.com/wwfassets/downloads/lpr2018_summary_report_spreads.pdf

Ecosystems provide the human population with much of what is essential to life, including food, water, and fresh air. Ecosystems are also essential for maintaining the balance of CO_2 in the atmosphere. All these services are imperilled under the current ecological emergency, and 65% are currently in decline. Although provided free by Nature, these services have been valued at over $125 Trillion per year; they are much too valuable to lose.

https://www.weforum.org/agenda/2018/10/this-is-why-putting-a-price-on-the-value-of-nature-could-help-the-environment/

3. Motivation for the Isle of Man to act

It is worth quoting statements from the UN in the run-up to the Climate Change Summit in New York in September 2019, when Secretary-General António Guterres called on all leaders to come with concrete, realistic plans to enhance their nationally determined contributions, in line with reducing greenhouse gas emissions by 45 per cent over the next decade, and to net zero emissions by 2050. Additionally, the UN stated: “To be effective and credible, these plans cannot address mitigation alone: they must show the way toward a full transformation of economies in line with sustainable development goals**.** They should not create winners and losers or add to economic inequality; they must be fair and create new opportunities and protections for those negatively impacted, in the context of a just transition”. “Accelerated climate solutions can strengthen our economies and create jobs, while bringing cleaner air, preserving natural habitats and biodiversity, and protecting our environment”. “New technologies and engineering solutions are already delivering energy at a lower cost than the fossil-fuel driven economy. Solar and onshore wind are now the cheapest sources of new bulk power in virtually all major economies. But we must set radical change in motion”. https://www.un.org/en/climatechange/un-climate-summit-2019.shtml

A recent report from EY (previously Ernst & Young) states that “those that respond proactively will create value for their clients, give themselves a competitive advantage, reduce systemic financial risks and make an invaluable contribution to society as a whole https://www.ey.com/Publication/vwLUAssets/EY-climate-change-and-investment/$FILE/EY-

climate-change-and-investment.pdf (see Executive Summary). However, those who fail to take action will soon experience the implications across the whole investment value chain, resulting in significant costs and damage to economies." There are many examples of the benefits of environmental improvements prompting increased efficiency, innovation and the development of new businesses and services and the creation of new markets. http://www.aldersgategroup.org.uk/asset/1477

There is evidently a risk that if the Isle of Man does not pursue a purposeful, planned and managed transition, then a chaotic transition may result. There will arrive a time, in the not-too-distant future, when many traditional products will no longer be available (*eg* petrol vehicles, gas boilers) as they are phased out in the international market place. If adequate preparations are not made locally then there will be no infrastructure to support the replacements (*eg* vehicle charging network, strengthened electric grid). In this sense, the climate action plan is a matter of national security.

3.1 Co-benefits

It is widely reported that there are many potential co-benefits to be gained from action on climate change.

(http://publications.iass-potsdam.de/pubman/item/escidoc:2348917:6/component/escidoc:2666888/IASS_Working_Paper_2348917.pdf)

Many of these will require active pursuit and will not occur automatically. Similarly, it is advisable proactively to avoid the potential disadvantages of a very limited number of possible climate mitigation actions.

https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/757068/Co-benefits_of_mitigation_-_FINAL_report_v8.pdf See conclusions, page 57.

Climate actions have multiple impacts:	
Potential co-benefits	Potential co-disbenefits
Energy security Air quality improvements Active travel health benefits Reduced congestion and noise Reduced accidents Energy security Warmer homes Integrated urban policies Reduced consumption/cost of materials Stimulated innovation Enhanced productivity Future job security Food security Community action Enhanced ecosystem services Reduced spend on future adaptation International cohesion	Bioenergy production competing with food production Nuclear energy Costs to public expenditure

4. Political Commitment

The Isle of Man Programme for Government is a well-placed strategic vehicle to act as a starting point for embedding zero carbon concepts throughout the Isle of Man government and wider community. The document already goes some way towards supporting goals of clear and effective leadership, energy security and emissions reductions, while taking care of nature and wildlife to help us deal with the challenges of a changing climate.

4.1 Explanation of net-zero

Firstly, it is worth explaining that there are several gases which contribute to climate change. The main gas is, of course, carbon dioxide CO_2 which arises predominantly from burning of fossil fuels (oil, natural gas, coal). Another important gas, found in lesser but increasing quantities in the atmosphere, is methane CH_4 which is the principal component of natural gas; it is around 25x more powerful in its climate impact per unit mass than CO_2, over a 100-year period. There are many other relatively minor gases which drive climate change including nitrous oxide N_2O, and a wide range of fluorocarbons, often referred to as F-gases, usually found in refrigerants. The sum total of the effect of a mixture of these gases is often expressed as carbon dioxide equivalent, or CO_2e (also expressed as CO_2eq) – which would be the amount of carbon dioxide which had the same overall effect in driving climate change. This basket of gases, which have a climate effect, are also called greenhouse gases (GHGs). More explanation is provided in Appendix 2.

A net-zero target http://www.lse.ac.uk/GranthamInstitute/news/what-is-net-zero/ refers to the end-point at which the great majority of territorial greenhouse gas emissions, expressed as CO_2e, have been very much reduced. However, it is recognised that a small amount will, undoubtedly, be very hard to remove completely – as things stand perhaps emissions from aviation and shipping, as well as some industrial processes and agricultural production. This small residual release of greenhouse gases must be balanced by an equal amount of CO_2e which is removed from the atmosphere. This is most obviously accomplished by increasing the amount of natural sequestration, by which trees, vegetation and marine plants use CO_2 from the atmosphere and turn it into woody materials, or carbon-rich compounds, deposited in the soil or seabed, where they remain locked up potentially for a very long period. Another route to remove carbon dioxide is through carbon capture and storage (CCS), whereby the gas is pumped into depleted underground oil or gas fields where, again, it can be stored in perpetuity. This remains a largely unproven technology, will be expensive, and is unlikely to be available to the Isle of Man. There are prospects, however, for direct air capture of CO_2 in future (Section f(v)).

5. Underpinning Principles

In 2017, UNESCO agreed a Declaration on Ethical Principles in Relation to Climate Change in which world leaders have called climate change the biggest challenge of the 21st century. The Declaration speaks of the responsibility to address the challenge, and reinforces the role of ethics at the centre of the discussion.

It sets out six ethical principles:

- Prevention of harm – anticipate, avoid and minimise harm, both from impacts and actions
- Precautionary approach – facing threats of serious harm, lack of full scientific evidence should not prevent or postpone preventative measures
- Equity and justice – fair treatment and involvement of all people; safeguard the planet for future generations
- Sustainable development – promote the UN sustainable development goals
- Solidarity – recognise the interconnectedness of physical, ecological and human systems and offer knowledge and assistance to groups vulnerable to climate change and natural disasters
- Scientific knowledge and integrity in decision-making – decisions should be based on the best available knowledge.

The UNFCCC puts the onus on developed countries to lead the way, but that should not be seen as a burden. As a modern and diverse economy with strong communities and attachment to the Island environment, the Isle of Man has many opportunities to take advantage of an enthusiastic, progressive and proactive approach to tackling climate change. The same motivation inspires the Isle of Man designation as a UN Biosphere, with focus on:

- Quality of life: Making sure we have the healthiest possible environment to support our wellbeing
- Economy: Helping to attract more investment to the Isle of Man
- Tourism: Raising awareness of our Island and making it an even more special place to visit
- National pride: A global accolade like this fosters pride in everything from our outstanding natural environment to our unique culture and heritage
- Stronger partnerships: Between the voluntary sector, businesses and government, helping everyone to achieve more.

The UN Biosphere is intended to promote the delivery of all 17 UN sustainable development goals - of which, of course, number 13 is “Take urgent action to combat climate change and its impacts”. Other particularly relevant goals for this action plan include 7: affordable and clean energy, 11: sustainable cities and communities, 12: responsible production and consumption, 15: life on land, and 17: partnerships.

In the Isle of Man Climate Challenge Mitigation Strategy 2016-2020 https://www.gov.im/media/1364557/2016-gd-0031.pdf, it was stated that when agreeing actions there would be consideration of:

- Effectiveness
- Achievability
- Impact on consumer costs
- Scope for local influence
- Legislative requirements
- International trends and influences
- Likely level of public support
- Ability to measure effectiveness
- Government stakeholder appetite and preferences
- Value for money
- Capacity for a ‘quick win’
- Capacity for a highly effective long-term outcome.

An important aspect is also to ensure a "Just Transition" which seeks to deliver a well-managed development of a sustainable, low-carbon economy, while respecting social justice, inclusion, welfare, a fair distribution of costs, decent jobs and particular protection for the poor, the vulnerable and the disadvantaged http://www.ilo.org/wcmsp5/groups/public/---ed_emp/---emp_ent/documents/publication/wcms_432859.pdf . The greening of an economy presents opportunity to be an engine of growth, and a net generator of decent, green jobs that can contribute significantly to general welfare. There is the chance to manage natural resources sustainably, increase energy efficiency and reduce waste and pollution, while addressing inequalities and enhancing resilience. However, it is important to be aware of some of the challenges including economic restructuring driving some job displacement, the risk of offshoring some work, the need for re-skilling, the possibility of some sections of society being left behind, and the possible impact of price changes creating poverty. A Just Transition requires the active engagement of civic society, becoming itself an agent for change. A Just Transition requires effort to make it happen (Appendix 3).

To maintain wide commitment and participation, it is sensible to seek the delivery of climate actions through voluntary behaviour change at personal and community level, and where possible to offer incentivisation through loans or grants. Direct regulation and prohibitions should be considered as a fail-safe, and introduced only with sufficient lead-in time.

It is also important to recognise that very many of the climate actions suggested in this report will also deliver population health benefits (Appendix 4). It is often fairly straightforward to estimate and calculate the costs of climate action, but it is much harder to estimate the costs of inaction, and equally to capture all the benefits, financial or otherwise, of those actions. It is important, as a motivational tool, that these multiple benefits be highlighted.

5.1 A Vision for 2050

Delivering on all of these combined concepts will create a better future for all the people of the Island. This is exemplified in the closing graphic, used in some of the public engagement events which supported the development of this Action Plan (Figure 1).

Figure 1: A vision for a better life on the Isle of Man

5.2 Target Setting

Appendix 2 provides a summary of how territorial greenhouse gas, or CO2e, accounts are compiled. It is with respect to the definition of the existing IoM territorial account, ultimately submitted to the UNFCCC as part of the UK account, that this action plan has been prepared.

The main elements of the account are shown in Figure 2.

Mean CO_2e emissions for the IoM, for the period 2007 to 2017 inclusive, are 830,000 tonnes per annum (or 0.83 Mt pa), with a standard deviation of 0.035Mt (Figure 3). So, emissions vary both up and down by more than 5% year to year, possibly caused by cold or mild winters, or perhaps outages of electricity generation. This is one of the reasons why it is inadvisable to set precise future carbon reduction targets, against which the Isle of Man Government will be held accountable for delivery.

Additionally, carbon accounts take around 2 years to be calculated, rendering emissions themselves a rather poor metric against which to measure progress in real-time, and by which to know when and how to intervene if the action plan is not being fully implemented. The scope and also the methodologies for calculating emissions, for return to the UNFCCC, are justifiably updated from time to time (*eg* https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2019) and this means there can also be significant step-changes in reported emissions. For these reasons, it is preferable to have a very limited number of milestone emissions targets, and to have time-lined actions for which it is relatively straightforward to determine progress in delivery and over which the Isle of Man has control. That is the approach taken in this report.

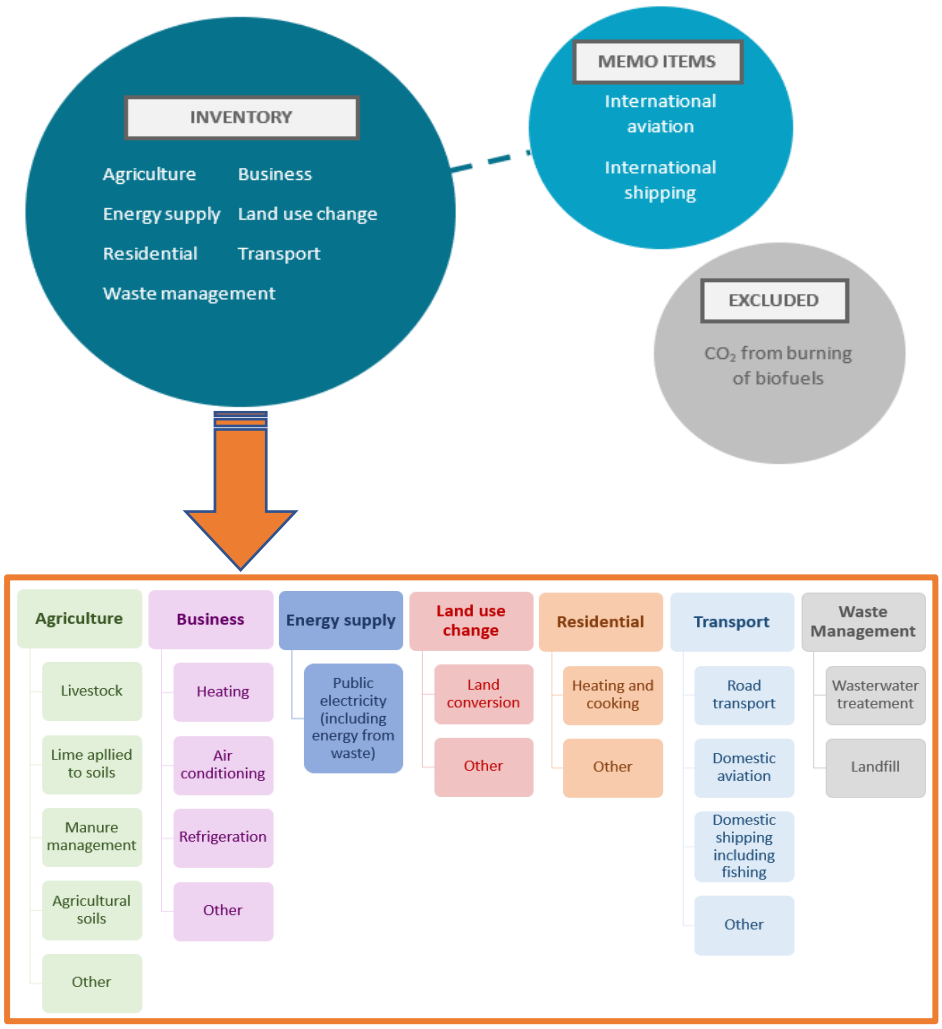


Figure 2: The main inclusions and exclusions in the IoM formal carbon account

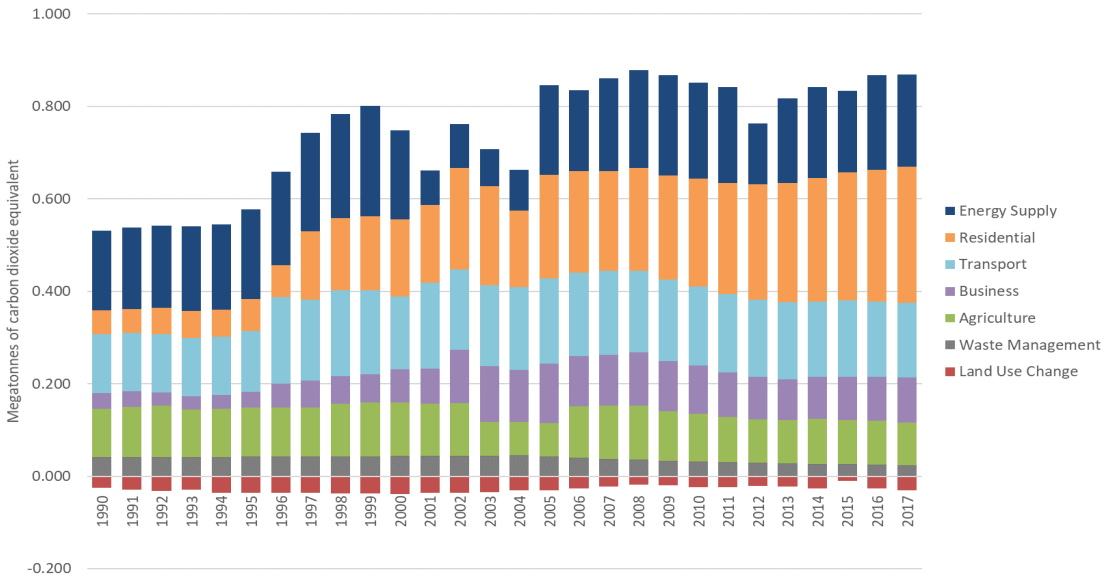


Figure 3: Reported IoM emissions (Mt CO_2e) by year

6. Building on Previous Work

GD 2019/0102

There has been much previous work done on climate change mitigation, and indeed adaptation, in the Isle of Man. This report and action plan has the advantage of building on previous thinking, of adopting the resulting proposals, of attempting to capture the existing ambition of organisations and people, and of learning from, and intending to incorporate, much of the existing knowledge and action already underway – such as the biodiversity strategy https://www.gov.im/about-the-government/departments/environment-food-and-agriculture/ecosystem-policy-and-energy/wildlife-biodiversity-and-protected-sites/biodiversity-strategy-and-delivery-plan/ and sustainable energy studies https://www.gov.im/media/624419/aeamainreport.pdf and the environment and infrastructure policy.

Key efforts already delivering change include the designation of the marine nature reserve, the Ayres nature reserve, and the network of ASSIs - all of which consider carbon management. The efforts of the Manx Wildlife Trust must also be recognised, for example in extensive tree-planting http://www.manxwt.org.uk/ , while the UN Biosphere programme https://www.gov.im/about-the-government/departments/environment-food-and-agriculture/unesco-biosphere-isle-of-man/ , the One World Centre, Climate Change Coalition and Youth Climate Strike all contribute to public outreach and engagement work https://www.oneworldcentreiom.org/ , as well as many others.

This ongoing policy development, delivery of actions, volunteer activity, and debate and leadership from members of Tynwald, has resulted in widespread support for further action. This is exemplified in the results of the recent public opinion survey:

https://consult.gov.im/environment-food-and-agriculture/climate-change-action-plan-2020-2030/results/climatechangemitigationactiondocument2019.pdf

For example, of the 1029 respondents:

- 93% believe further awareness raising is necessary
- 87% would like to see a funding package to support energy efficiency
- 92% support community renewable energy projects
- 76% support phasing out of fossil-fuel boilers
- 86% support grants or loans to purchase electric vehicles
- 77% believe the sale of fossil-fuelled vehicles should be phased out
- 86% want to see renewables supplying electricity by 2030
- 80% agree with onshore wind generation, and 89% with solar panels and battery storage
- 80% agree with the idea of a climate change levy or increased taxation.

7. Approach to the Task

At the outset it was decided to use the internal resources of the IoM Government to create the technical and evidential base for this report. Within 3 weeks, all relevant Departments identified and offered experienced staff to support the very demanding task of gathering evidence and preparing individual reports for an initial 50 or more workstreams. The staff were available both full & part time and were co-located. The concept was that these individuals would bring with them their broad experience and policy understanding from their own Departments, they would be able to draw on their own networks of internal and external connections, they would offer fresh perspectives and ideas, and would support and challenge each other within what was called the Analytical Team. Some staff were very

knowledgeable on climate change, others less so and training was provided. It should be emphasised that the staff and their Departments were fully aware that the individuals were not expected, necessarily, to represent a particular Department, or to promote or support any individual existing policy lines.

Guidance on expectations and ways of working was provided (see Appendix 5).

The Analytical Team was encouraged to seek input from relevant stakeholders, as well as attending and facilitating a number of wider stakeholder and public workshops. Some external consultancy was used to sense-check and to challenge draft reports, and where required to deliver some commissioned studies. Appendix 6 includes a complete list of all contacts made.

There is no question that this approach has been successful. The Analytical Team has provided exemplary input, working well beyond normal expectations, with an inspiring degree of interaction and interdisciplinarity.

The further added-value is that, hopefully, beyond the end of this first phase of creating the independent climate action plan, there will remain a network of skilled, capable and motivated individuals across Government who will be ready and willing to support the all-important next stage of delivering the actions.

8. Possible Pathways

Two possible pathways for the Isle of Man to reach net-zero by 2050 are explored further in this report. Both are based on the scientific analysis provided by the IPCC. A lower ambition pathway achieves an interim target of -25% reduction in CO_2e territorial emissions by 2030, relative to a 2010 baseline. This would meet the global requirement to limit planetary warming to +2^{o}C. A higher ambition pathway would achieve an interim target of -45% by 2030. This meets the requirement for a +1.5^{o}C world.

The EU's current pledge is a 40% reduction by 2030, against a 1990 baseline.

This report strongly recommends the higher ambition pathway. Many may argue that even greater ambition is required, particularly since the Paris Agreement takes cognisance of past emissions and expects developed countries to "continue taking the lead" (Article 4, para 4 https://unfccc.int/sites/default/files/english_paris_agreement.pdf.). However, a comparison with leading countries around the world which have done most, so far, to tackle climate change indicates that a 45% reduction in emissions within one decade is indeed very challenging. However, this report suggests that it is achievable for the Isle of Man.

8.1 Higher & lower ambition pathways

The latest IPCC studies suggest that a 45% reduction, by 2030, against a 2010 baseline, is required of net global CO_2 emissions to achieve a limit of +1.5^{o}C in global warming. For a limit of +2^{o}C, the equivalent reduction is 25%.

https://www.ipcc.ch/site/assets/uploads/sites/2/2019/05/SR15_SPM_version_report_LR.pdf
See section C.1

Note that it is estimated that methane CH_4, for example, is required to decline marginally less, by 35% by 2030, in the higher ambition pathway. However, no particular distinction for different greenhouse gases is made within this report.

The higher ambition pathway advocated here (Figure 4) offers a 45% reduction by 2030, while the lower ambition pathway offers a 25% reduction by 2030. Both end at net-zero in 2050.

For comparison, the UK has sometimes achieved a reduction of 3% per year in carbon emissions. Scotland has achieved 5% over the period 2010 to 2015, but is usually closer to 3%. A study has shown only ¼ of 18 leading economies have achieved in excess of 3% reductions, and then only relatively marginally https://www.nature.com/articles/s41558-019-0419-7 .

So, in Figure 4, a decline of emissions of -3% pa is certainly not unusual, particularly when some early wins are likely. Whereas, setting a rate of -6% pa is ambitious, but should be achievable.

It is worth noting that, in any case, the lower ambition pathway has to catch up in the period after 2030, in order to meet net-zero by 2050, and its initial decline in that phase needs to achieve -5% pa, whereas the higher ambition pathway requires -3.5% pa.

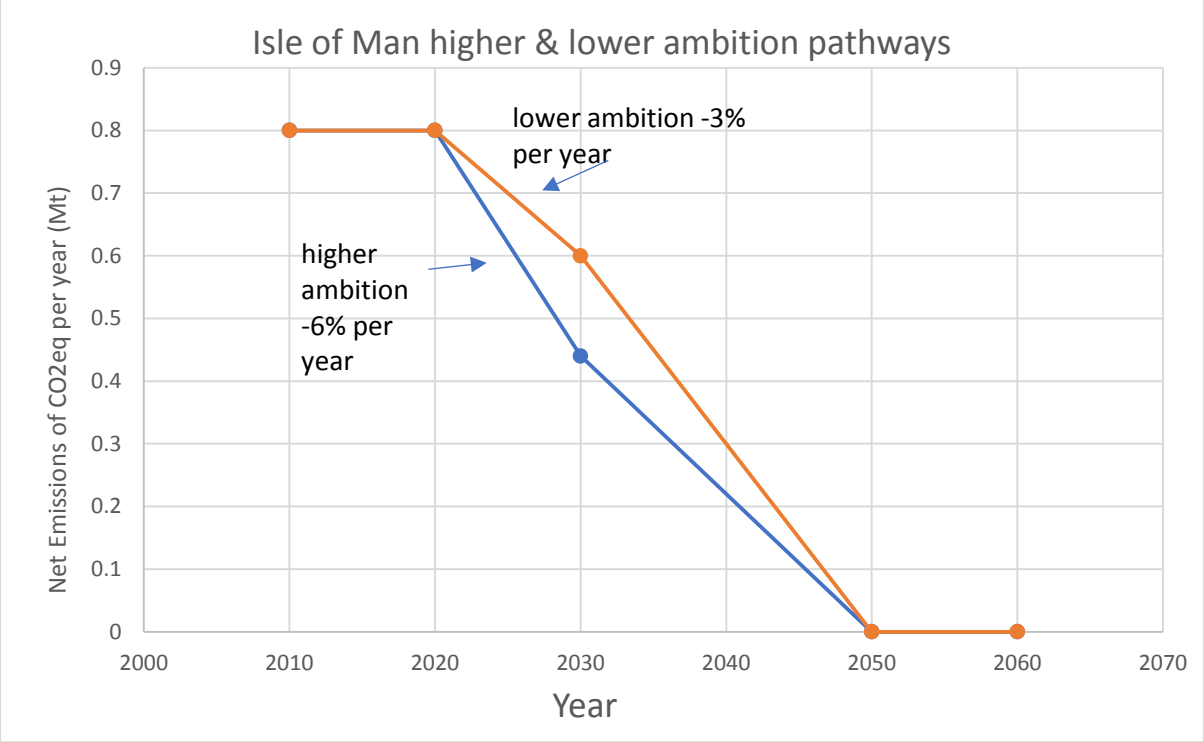


Figure 4: Illustration of the higher and lower ambition pathways

8.2 Higher ambition scenario for 2020 to 2030: 45% reduction in greenhouse gas emissions by 2030

This pathway is, on the global scale, compatible with +1.5°C warming, with >50% certainty and no, or limited, overshoot.

The scenarios presented in the following two tables, address 5 key action areas for the first 10 years. These 5 areas cover around 80% of current IoM carbon emissions. Commercial/industrial and agricultural emissions more or less account for the remaining 20%. Of course, actions will be pursued in those sectors as well, which will provide some additional headroom (See the action tables in Section 13.1).

The total cost (public + private) for the higher ambition pathway for the first 10 years is estimated as £52M per year, which is just above 1% of GDP as expected (See page 8 in https://www.theccc.org.uk/publication/net-zero-the-uks-contribution-to-stopping-global-warming/ where it is estimated that net-zero for the UK will cost between 1% and 2% of GDP). The total risk score is 25 (risk analysis is explained below in Text Box 1, and in Appendix 5).

Text Box 1: Note on Risks The risk associated with delivery of the higher ambition pathway is estimated as 25, derived from the total score in the matrix shown in Appendix 5. This is an estimate based on professional judgement. For example, a delivery timing risk of 3 and a financing risk of 2 would provide an overall risk of 3x2 = 6 for that activity. The risk scores are summed across the 5 major emissions reduction action-areas in the following table to provide a total of 25. Disaggregation of the risks suggests that the timing risk is higher, at an average of 2.7, compared to the financing risk at an average of 2.4. This is not too surprising as the timescales in the higher ambition pathway are certainly demanding, whereas much of the public financing would be provided by allocation of fixed annual budgets which, if oversubscribed, would result only in a queue of applicants being created for the following year.

Higher ambition: Analysis of 5 key actions covering 80% of emissions, 2020 to 2030					
Action area	Peatland restoration and forestry planting	Energy efficiency in buildings	Electricity generation by renewables	Heating of buildings	Vehicles
Current contribution to IoM emissions	-5%	0	25%	35%	20%
Status under scenario	Extensive restoration, rapid forest planting	All surveys complete, and high uptake	Onshore wind 150MW Onshore solar 50MW	All oil-fired conversions complete	Third of vehicles are electric (20,000)
Contribution after 10 years	Additional -3%	-10%	-15% CCGT operating 1/3 of time	-10% Electricity not yet zero-carbon	-7% Electricity not yet zero-carbon
Cost public/ private	£25M public	£8M public	Private investment of approx. £200M, but grid also needs strengthening: costs approx. £65M, offset by increased gross profit of £5M pa	£112M public	£50M grants, plus loss of fuel duty and annual licence = £85M. Public charge points provided by commercial operator
Risk factor	2	4	4	9	6

Assumptions: using purely indicative numbers which need further substantiation:

(i) 6000 hectares of new woodland at grant of £3000 per hectare, includes 5 year maintenance, https://forestry.gov.scot/support-regulations/forestry-grants Sub-total = £18M. Plus 9000 hectares of peatland restoration at £800 per hectare. Sub-total = £7M https://www.see.leeds.ac.uk/fileadmin/Documents/research/sri/peatlands/The_costs_of_peatland_restoration_in_Scotland_report.pdf see page 18.

Total = £25M

(ii) Basic insulation: For lofts and floors £300 https://www.renewableenergyhub.co.uk/main/insulation-information/insulation-cost-and-savings/ LEDs = £50. Water saving = £50. https://www.which.co.uk/reviews/electric-showers/article/how-to-buy-the-best-eco-shower-head/eco-shower-heads-top-picks Secondary glazing for a typical property = £1800. https://householdquotes.co.uk/secondary-glazing/ . Total = £2200, but assumed to be around £2000 with a major contract overseen by the IoM Government.

So, 40,000 buildings with interest free loan of £2000 each (total £80M investment), paid back over 10 years. So, subsidising 2% interest = on average outstanding loan of £40M = £0.8M pa for 10 years = £8M.

(iii) Average £7000 per oil-fired household (16,000 premises) for conversion to electric heating by air-source heat exchanger or, in other cases, cheaper alternatives such as electric boilers or storage heaters (https://www.evergreenenergy.co.uk/heat-pumps/much-heat-pump-cost/). Electric wet heating is cheaper to install, being up to £4000 per household (https://www.greenmatch.co.uk/boilers/combi-boilers/electric-combi-boilers but more expensive to run, although off-peak tariff would make it comparable. Storage heaters will be cheaper again, typically a few hundred pounds per unit (https://www.which.co.uk/reviews/home-heating-systems/article/home-heating-systems/storage-heaters). Off-peak tariff is <1/2 regular tariff. Estimated total cost = £112M.

(iv) No fossil-fuelled vehicle registrations after 2032. Typical £4000 subsidy to purchase electric vehicle, reducing to zero in 2030. Plus £500 for domestic charging point. So average £2000 for 20,000 vehicles, plus £10M for chargers. Total expenditure = £50M. With 1/3 of all vehicles paying no annual licence fee by the end of 10 years then the loss of revenue is £15M. Public vehicle charging points can be supplied and installed commercially, for which the necessary investment might be around £5M. Expected these 20,000 vehicles will be the more regularly-used, so emissions will, by 2030, be around half of current but charging electricity will not yet be zero-carbon. With only 1/2 petrol/diesel being used by the end of 10 years, then on average 1/6 of fuel duty will be lost = £70M over 10 years.

Total cost to the public expenditure over 10 years is £280M, or about £28M each year. Note this excludes the cost of grid-strengthening, around £65M, which falls to the Manx Utilities Authority (MUA) (see Text Box 2). There will also be some small new public income streams: perhaps £2M to £3M per year for rental of onshore and offshore windfarm and solar sites, reducing the **public cost to around £25M per year**.

Total private investment is additionally approx. £270M: this is required for investment, in this scenario, for provision of onshore wind and solar generation, as well as offshore wind farms, and in a commercial vehicle charging network. Many companies will likely express interest: for example, Ørsted, Vattenfall, Iberdrola for wind development; Lightsource, Solarcentury and many others for solar developments; Chargepoint, BP Chargemaster, RWE and again many others for vehicle charging networks. No endorsements are intended. The MUA will also need to invest for the future in its infrastructure, but on the basis of recovering the investment through increased retail sales.

The combined cost is near £52M per year, just above 1% of the IoM GDP.

It is worth noting that the estimated IoM public expenditure of £25M per year corresponds to around £300 per head. For the UK, where climate change action is estimated to cost between 1% and 2% of GDP, and assuming an equal public/private split, as in this scenario, then the public expenditure cost per head would be in the range £150 to £300. So, the IoM figure lies at the upper end. Some of this discrepancy arises because of the IoM's large GDP relative to its population, but, additionally, the UK Climate Change Act was in 2008 - so there has been a more extended period over which to spread costs.

Additional emissions reductions will be achieved by the agricultural and commercial sectors; they are likely to be funded either through existing mechanisms (Agriculture Development Scheme and business grants) or entirely privately. Also, the remaining diesel power generator can either be decommissioned completely, or potentially convert to biodiesel and continue to generate for high-value export. It is likely these additional factors will provide a few percentage points of headroom should it be, as is likely, hard to achieve high uptake of oil-heating substitution in particular.

8.3 Lower ambition scenario for 2020 to 2030: 25% reduction in greenhouse gas emissions by 2030

This pathway is, on the global scale, compatible with +2^{o}C warming, with >66% confidence.

This scenario again addresses the 5 key action areas for the first 10 years. These 5 areas cover around 80% of carbon emissions. Commercial/industrial and agricultural emissions account for the other 20%. Of course, actions will be pursued in those sectors as well, which will provide some additional headroom (See the action tables in Section 13.2).

Total cost (public + private) is £26M per year, which is around 0.5% of GDP. Total risk score is 15. With an average finance risk of 1.8 and a timing risk of 1.7.

Lower ambition: Analysis of 5 key actions covering 80% of emissions, 2020 to 2030					
Action area	Peatland restoration and forestry planting	Energy efficiency in buildings	Electricity generation by renewables	Heating of buildings	Vehicles
Current contribution to IoM emissions	-5%	0	25%	35%	20%
Status under scenario	Half potential restoration, half forest planting	All surveys complete, but low uptake	Onshore wind 100MW Onshore solar 25MW	Half of oil-fired conversions complete	10,000 vehicles electric
Contribution after 10 years	Additional -2%	-5%	-10%	-5%	-3%
Cost public/ private	£12M public	£4M public	Private investment of around £125M, but grid also needs strengthening: costs approx. £40M offset by increased gross profit of £2.5M pa	£56M public	£25M subsidies, plus £43M loss of duty and licence fee revenue. Public charge points provided by commercial operator.
Risk factor	1	2	4	4	4

Assumptions: More detail is provided in the previous table. Purely indicative numbers are used which need further substantiation:

(i) 3000 hectares of new woodland at £3000 per hectare. Subtotal = £9M. Plus 4500 hectares of peatland restoration at £800 per hectare. Subtotal = £3.5M. Total = £12M.

(ii) 20,000 buildings with interest free loan of £2000 each (total £40M investment), paid back over 10 years. So, subsidising 2% interest = on an average outstanding loan of £20M = £0.4M pa for 10 years = £4M.

(iii) £7000 per oil-fired household (16,000 premises) for conversion to electric heating by air-source heat exchanger, but only half (8000) uptake. Total = £56M.

(iv) No fossil-fuelled registrations after 2035. Typical £4000 subsidy to purchase electric vehicle, reducing to zero in 2030. Plus £500 for domestic charging point. So, average £2000 for 10,000 vehicles, plus £5M for chargers. Total expenditure = £25M. With one quarter of regularly-used vehicles not using petrol/diesel by the end of 10 years, then on average 1/8 of fuel duty will be lost = £35M over 10 years. With one sixth of vehicles paying no annual licence fee by the end of 10 years, then the loss of revenue is £8M. Public vehicle charging points can be supplied and installed commercially. The necessary investment might be around £3M.

Total cost to the public expenditure over 10 years is £140M, or about £14M each year. Note this excludes the cost of grid-strengthening, around £65M, which falls to the Manx Utilities Authority (see separate note). There will also be some small new public income streams: perhaps £0.5M to £1M per year for rental of windfarm and solar sites, reducing **the public cost to around £13M per year.**

Total private investment is additionally approx. £125M

The combined cost is near £260M, or £26M per year, close to 0.5% of IoM GDP.

Text Box 2: Further detail on electricity grid upgrade

Appendix 15 b indicates the cost of rewiring of the IoM low-voltage grid would be an investment of less than £1M for some limited renewables connectivity, which could facilitate some immediate progress.

However, in the medium term, much more is needed to balance a grid with high renewables penetration and it is estimated that the strengthening and increased flexibility required of an electricity grid to operate with stable frequency and ability to respond rapidly to fluctuating demand, as well as cope with peak demand, is in the range £5 to £20 per MWh. At mid-range, £12.5 per MWh, this represents about ¼ of the quoted investment required to provide the wind energy generation.

https://www.carbonbrief.org/in-depth-whole-system-costs-renewables

https://www.theccc.org.uk/wp-content/uploads/2019/04/Technical-Annex-Integrating-variable-renewables-into-the-UK-electricity-system.pdf

If, by 2030 under the higher ambition scenario, the IoM has established 150MW of onshore wind generation and 50MW of solar generation, then the total power is 200MW but, with a load factor of around 35% for wind and 10% for solar, suggests a total delivery across the year of around 500,000 MWh, implying a new grid strengthening/stabilising cost of £6.5M per year. It should be noted this figure is very uncertain.

By 2030, if half of IoM homes are running heat pumps and 20,000 vehicles are electric then, conservatively, the increased consumption of electricity might be around 50,000 MWh and 20,000MWh respectively, suggesting a total additional consumption of 70,000MWh compared to current levels of 360,000MWh. This is an increase of about 20%. The gross profit of the electricity utility is around £27M (2017/18 annual report https://www.manxutilities.im/media/1744/manx-utilities-annual-report-201718-v21.pdf see section 5) so an additional profit of £5M might be anticipated. This will approximately offset the grid strengthening costs.

9. Delivery of Actions: suggested governance model

Any action plan will ultimately only be as good as its delivery. The mechanisms for delivery, or the governance, of an action plan are critical to success. The main elements of good delivery must comprise:

- Clarity on the business justification for the action plan
- Building on lessons learnt from past experience, both good and bad
- Identifying very well-defined roles, responsibilities and accountabilities
- Disaggregation of a programme into manageable stages/projects
- Management by exception, focusing resolutely on what's wrong and correcting it
- Determined delivery of outputs.

There must be additional, real-time, underpinning processes in place for ensuring:

- Quality control of analysis and outputs
- Ongoing planning: setting milestones and targets
- Risk management and implementing mitigations
- Change authorisation: formalising and approving any deviations
- Boundary management: ensuring there is no mission drift
- Inter-dependency tracking: awareness of intended and unintended consequences, and of co-benefits or dis-benefits
- Monitoring of deliverables
- Reporting regularly to an executive board and, in this case, publicly
- Encouraging challenge.

It is essential that the eventual climate change action plan is delivered through a formally established and long-term programme management structure.

There are various well-established formal programme management techniques that seek to integrate all of these elements into a working model, perhaps the best-known being PRINCE2, originally developed by the UK Government although the rights are now privately owned. No endorsement is intended here. It would be appropriate for the Programme Executive Board to comprise the Council of Ministers, with subsidiary Project Boards assuming responsibility for the delivery of actions within particular sectors. There should be a manageable number of project boards, perhaps around 6 focussed on sectors such as: land management, business, energy, built environment, transport, and communications. Dedicated professional project managers would be essential to support the boards.

Beyond these formal structures, a useful role might also be provided by a Citizens Panel, populated by appropriate individuals and representatives of civic organisations, who would receive regular reporting and who could scrutinise and challenge progress, but also offer advice on societal response, and act particularly to monitor against the principles of a Just Transition.

There are principles which should be adopted by the governance structure in delivering climate actions, and these are listed in Section 5. They would include awareness raising amongst, and motivation of, stakeholders and civic society, openness, fairness and inclusivity, incentivisation initially and adequate lead-in time to any subsequent regulation or legislation.

10. Detailed actions by sectors

A wealth of information is provided in the Appendices as an evidence base upon which the following sections and derived actions (Sections 13.1 and 13.2) draw. The individual appendices describe the current situation, the challenges and opportunities as well as the options for future change. In taking forward the recommended action plan (Section 13.1), the evidence in these Appendices will provide a very useful starting point for developing more detailed management and delivery plans.

a) Review Cycle for Plan

This action plan is based, as far as practicable in the time available, on a body of evidence collected and synthesised by the Analytical Team and presented in the various appendices. However, it is recognised that there are many apparent gaps in evidence, which are summarised in Section 11. Undoubtedly there will be many other inadequacies which are not yet immediately apparent. For this reason alone, it is strongly recommended that this action plan be reviewed and updated within 3 years. This, of course, does not mean that there should be any delay in pursuing all the actions listed in this Plan. Those in the early years, in particular, are well-founded and are no-regrets actions.

It is widely recognised that climate change mitigation actions must be regularly reviewed. The underlying science of climate dynamics is constantly progressing; our understanding of natural sequestration advances; the available technologies for reducing carbon both diversify and improve; the costs of new technologies drop; society and governments shift their expectations and ambitions. It is commonplace for climate action plans to be regularly reviewed on a five-year cycle and that practice should be adopted by the Isle of Man following the first, earlier, review.

b) Offsetting

There is evidence that many companies, developers and individuals wish to offset their own carbon emissions. This can be an ethical decision but also, through some offsetting schemes, it can be officially recognised against the reported emissions from a business. There appears, currently, to be no offsetting scheme available that specifically recycles funds into actions that would help the Isle of Man to achieve its own carbon reduction targets.

It is strongly recommended that the Government rapidly investigates various options (Appendix 7) to establish a route to offer voluntary emission reductions, adopting published standards so that verifiable credit can be offered. It is essential that the offsetting actions are delivered in an efficient way, with minimal overheads, and can be fully and publicly audited.

The targets for offsetting could be through supporting and enhancing natural sequestration, via woodland creation and peatland restoration, or in future encouraging sequestration in marine ecosystems, or by funding installation of energy-efficiency measures. An important aspect is that all offsetting actions should provide additionality and not simply displace funding that would otherwise have occurred.

There is an opportunity that such audited offsetting could also facilitate any future stipulation in the land use planning system for net-gain, or net-zero, standards applied to new developments (Section 10(m)(iv)).

c) Education, Awareness, Engagement

Now that climate scepticism and the attendant undermining of accumulating evidence has been marginalised, there is rapidly growing societal understanding and acceptance of the fact of climate change, its progress, and the risks of future impacts. However, there is less understanding of the details of all the necessary mitigation and adaptation actions, their costs and their implications for every aspect of civic society. Education, awareness and engagement are essential to the successful delivery of a national climate action plan. The Manx population has the right to know what to expect, what sorts of decisions will be made in future, what the costs might be, and which of those decisions will directly affect their home and work life. Hopefully, this understanding will generate support for some decisions, made by Government and businesses, which will challenge past practice and require change. It is important that all citizens recognise the need for change, and the benefits, both locally and globally, of those changes as well as the availability of information and support.

A structured programme of public information, awareness, advice and education should be launched immediately – well in advance of other necessary climate actions. The programme should be based solidly on analysis of sectoral and individual needs and of the most suitable mechanisms for communication (See Appendix 8). This programme should continue throughout the lifetime of the action plan.

Closely related, it is important also that school students are offered the opportunity to learn about climate change (Appendix 9) which will remain a feature of their lives for many decades to come. Climate change has recently been referenced in the IoM curriculum statement, while the independent King William's College also embeds climate change across various disciplines. Climate change, as a subject, offers a great opportunity to integrate many separate strands of learning: science, geography, history, economics and social studies, as well as outdoor activities. The Biosphere project is currently working with schools on the UN sustainable development goals. It is recognised that the IoM has a non-prescriptive approach, with delegated authority to head teachers for specific curriculum offers. However, it is strongly recommended that both UN and UNESCO guides on education for climate change are used as prompts to establish comprehensive training in all IoM schools. The IoM Student Climate Network has called for this action, and there is perhaps still an opportunity in the Education Bill 2019.

d) Peatland, Woodland, and Ecosystems

The enhancement of various ecosystems is particularly important to provide the natural sequestration of carbon, thereby providing the future compensation for some remaining, and potentially unavoidable, carbon emissions in 2050 (see Section 4.1). The most practical providers of natural sequestration include peatlands, woodlands, wetlands, saltmarshes and seagrasses. These ecosystems provide many other significant benefits including amenity, recreation, biodiversity, natural flood risk alleviation, and raw materials.

Although more information, from survey work, is required on all the sequestering ecosystems, it is urgent that early action be taken on terrestrial carbon sinks as they usually take some years, or indeed decades, to respond and to increase their sequestration rates significantly.

It is suggested, based on limited evidence, that the IoM's 10,000 hectares of upland peat deposits currently hold around 20MtCO_2e (Appendix 10a), equivalent to around 25 years of emissions from the Island. This stock of carbon is effectively in public ownership, on the uplands, but is vulnerable to land management practices - so stabilisation alone is important. However, maximum restoration and continuing good management of all the IoM peatlands,

both upland and lowland, could provide a CO_2e emissions reduction of up to 9%, at maturity, relative to the 2010 national emissions baseline. Peatland emissions, or sequestrations, are about to be included formally in the UK submission to the UNFCCC.

Trees on the Island, currently covering almost 10% of the land surface, at around 5500 hectares, sequester around 70 $kTCO_2$ per year (Appendix 10b), or about 8% of man-made emissions. The great majority of this tree cover is on public land. Scotland currently has almost 20% tree cover, with rapid planting continuing at a rate of over 10,000ha per year, so it is not unreasonable to assume perhaps adding an eventual 6000 hectares additional woodland, to reach a stretching coverage target of 20% for the IoM. This could add potentially a further 8% reduction in emissions, at maturity, within the terrestrial account.

Note that in the tables in Section 8.2 and 8.3, the added sequestration is suggested as much lower. This is because the forecast is for 2030 and the newly planted woodland and restored peatland will not yet be functioning at full potential.

Reforestation, while being sensitive to location for planting, species, to biodiversity interests, and to disease resistance, along with peatland restoration and wetland creation, will considerably improve habitat diversity and, with good planning, the connectivity of existing natural and semi-natural habitats. This not only provides resilience for flora and fauna in the face of inevitable climate change impacts, but also further enhances broader carbon sequestration and other ecosystem services https://science.sciencemag.org/content/362/6412/eaau6020 .

e) Energy Efficiency in Buildings, including Public Buildings

Energy use in buildings is the single biggest contributor to IoM territorial carbon emissions, amounting to 35% of the total; space heating by appliances that burn fossil fuels is overwhelmingly the largest single factor.

Government could usefully take the lead in promoting energy efficiency across its estate (Appendix 11). Government has around 800 premises and 1200 social housing units, with an estimated energy usage costing about £15M per year. There are a further 5000 homes in the total social housing stock, but managed by other landlords. An urgent strategic review is required to gather detailed data, not just on energy performance but also on wider efficiency elements, such as use of buildings and accessibility for users.

A first step could include energy audits, the centralisation of energy data and budgets, and provision of a budget for competitive bidding by premises and/or departments to reduce emissions – either through installation of low-energy technologies or fitting renewable generation. In the longer-term, consideration should be given to the overall efficiency of service provision through assessment of sharing of facilities, remote working, and online access. Government should consider setting its own net-zero target.

All other premises, of course, need addressing as well (Appendix 12). Previous efforts such as “Energy Doctor” have shown some success but not at the scale now required. A new and very proactive programme can also help to reduce, or eliminate, the prevalence of fuel poverty on the Island, which currently stands at over 10% of households.

The current average SAP (standard assessment procedure: an energy efficiency measure) rating for houses is 53, but with no apparent improvement over the past decade. Building regulations have recently been changed to introduce an escalator so that all new-builds will be net-zero in 12 years’ time. Arguably, this could be accelerated.

Current uptake of the IoM Energy Efficiency Scheme is very low. Grants are provided at 75% rate, capped at £1k per household, and with means testing. These conditions are too restrictive.

It is recommended that an Energy Performance Certificate (EPC) becomes mandatory when selling any building. This will help inform purchasers and raise awareness of energy efficiency. It is essential that an energy efficiency advisory scheme is robustly promoted. This could be delivered by the private sector, but overseen and audited by Government to provide the reassurance that it is honest and fair. Interest free loans of say £2000 per home could be offered by Government to install fairly basic draught-proofing, loft insulation, secondary glazing, and low-energy bulbs and water-saving devices. Pay-back on lower energy bills will be sufficient to pay off the loans within a few years. Householders, of course, could be encouraged to invest more themselves, potentially for additional financial savings and comfort.

Many such energy efficiency schemes have not generated high uptake. Thought must be given about ways to ensure there is neighbourhood involvement. Trust and confidence in the advice offered and the materials supplied is paramount, but awareness and publicity will also be key.

f) Energy Supply

The Isle of Man energy policy is explicit about the importance of maintaining the security of energy supply on the Island. At the moment, security is provided, to a large degree, by the inter-connector cable and gas pipeline to the UK. However, it is worth remembering that there have been concerns recently expressed in the UK about security of energy supply, due to low margins on electricity generation capacity and the low level of gas storage, around 12 days, as well as increasing reliance on imports (10% of electricity for example) – all of which raise risk of supply disruption due to loss of key infrastructure or extreme events. Both security of supply to the Island and volatility of prices could result.

https://www.ofgem.gov.uk/sites/default/files/docs/2015/07/electricitysecurityofsupplyreport_final_0.pdf see page 10

https://www.oxfordenergy.org/wpcms/wp-content/uploads/2013/01/NG-72.pdf?v=79cba1185463

There remains a good argument that the IoM should retain a high degree of self-reliance in provision of energy.

i) Existing Generation

The Isle of Man currently derives its electricity supply from the Pulrose CCGT in Douglas, rated at 130MW, plus two smaller diesel generators in Peel (40MW) and Ramsey (3.6MW, but now closing), and the energy-from-waste (EfW) plant at Richmond Hill, which typically runs at 3MW and claims to supply 10% of the current Island electricity demand. There is a small hydro-scheme at Sulby (1MW). There is also a sub-sea interconnector, rated at 65MW, linking to the UK grid. It is clear that the recommendation to adopt the higher ambition pathway, with 45% reduction in emissions by 2030, will impact on several of these generators. It is suggested that the remaining diesel generator be decommissioned or, potentially, if commercially and technically viable, be converted to run on bio-diesel. The EfW plant should proactively seek to make use of its waste heat, which is likely to approach 50% of its total energy output and is currently not utilised - although it is accepted that this may not be easy (Appendix 13 a, b, c). The EfW plant could also usefully accept

combustible waste that may, currently, be burned in uncontrolled ways across the Island and it could also take forestry waste in future - as woodland cover is increased. Collection of domestic waste could be rationalised and efficiency improved. The plant would then run more efficiently and would produce a higher fraction of net-zero electricity.

Under the higher ambition pathway, the Pulrose plant will, quite likely, by 2030 only be generating at around 30% of its current utilisation in order to cover the intermittency of onshore and offshore renewables supply. The debt situation of the Pulrose plant need not be a barrier to adoption of new renewable energy sources as the renewables themselves begin to generate valuable new income streams.

Both the Electricity Act (2006), as amended in 2010, and also the existing Energy Policy (2006) merit review to facilitate a more rapid promotion of renewable energy sources.

ii) Onshore Wind/Solar Generation

It is known (Appendix 14) there are up to 8 suitable sites for onshore wind generation around the Island, capable certainly of delivering around 60MW average supply, with a peak of around 150MW. With ambition, the wind generators could be operating within 3 years (see page 5 of:https://www2.deloitte.com/content/dam/Deloitte/global/Documents/Energy-and-Resources/gx-er-deloitte-establishing-the-wind-investment-case-2014.pdf). As Section 10(f)(iv) indicates, there appears to be capacity for around 20MW of renewables generation to be accepted onto the existing grid and it is recommended that an immediate call be made for expressions of interest, now that the strike-price is competitive with gas-fired power generation. Mechanisms should also be explored to create local community benefit.

Solar photovoltaic installations have become rapidly both more efficient and cheaper and now often generate power at well below the rate for gas-fired plants. The barriers to solar generation above 50kW capacity should be removed (Appendix 15) to encourage more rapid deployment; currently there is only one installation of this size on the Island, but even it is curtailed if power output exceeds the 50kW threshold. The operators claim a pay-back period of 5 years on the investment. Such utility-scale development of solar farms should be encouraged, up to 50MW in the higher ambition scenario, to provide increased resilience of renewables supply. Care needs to be taken in siting such developments in order not to sterilise otherwise useful land. Although utility-scale solar plants are more cost-effective, the potential for much smaller domestic-scale provision should continue to be promoted.

Many individuals would doubtless wish to install their own domestic solar generators. The panels are now cheaper and efficiencies improved sufficiently that export feed-in-tariffs are probably no longer required to encourage uptake. The Irish model (Appendix 15 a, see page 10) indicates that a package of relatively small panels, integrated with a domestic battery, which together reduce household consumption at the retail tariff, can pay for itself within 8 years. This represents an attractive investment with a 12.5% annual return. Government could broker a trustworthy supplier deal which would reassure potential customers.

iii) Offshore Wind

From initial proposal, it can be only 5 years for offshore wind generation to commence (https://www2.deloitte.com/content/dam/Deloitte/global/Documents/Energy-and-Resources/gx-er-deloitte-establishing-the-wind-investment-case-2014.pdf). The latest strike price of offshore wind-generated electricity is now just below the market rate for gas-generated power, and therefore no longer needs a subsidy (Appendix 16). The ongoing delays in developing the Ørsted offshore lease, in Manx territorial waters, has been due to lack of clarity over contract-for-difference arrangements in the UK; but the emerging

prospects of power purchase agreements (PPAs) between generators and suppliers may well obviate such obstacles in the near future. The wind development could then proceed rather rapidly, with options available for how much of the generation the IoM may wish to purchase. This project would provide for a 700MW array, with a likely load factor in excess of 50% - meaning that peak power supply could reach 700MW and, on average, allowing for intermittency, it would supply more than 350MW. This single development could provide, on average, all of the IoM requirements even after elimination of, and substitution for, all fossil fuels (gas, oil, petrol, diesel). Other offshore developments should be actively pursued.

iv) Grid Strengthening

The existing IoM grid is able to accept a limited supply of renewable generation, perhaps up to 20MW capacity, and the local distribution, low-voltage, grid can be upgraded relatively cheaply to facilitate the installation of some heat pumps and electric vehicle charging points (Appendix 15). However, beyond this first phase, significant reinforcement of, and dynamic management of, the high-voltage grid will be required. By 2030, with suggested 60% penetration of renewable supply, then the annual cost of this grid enhancement may amount to an additional cost of £6.5M. This figure is very imprecise and subject to numerous local influences. The enhancements would include increasing cable capacity, connection to specific locations for renewable generation, dynamic balancing of the grid, installation of storage including batteries and, possibly, cryo-batteries using liquified air as the fuel for turbine generators. It would also be expected that offshore wind farm developers would look at upgrading sub-sea interconnectors to the UK (Appendix 15 c).

v) Other Renewable/Low-carbon Sources

There is the potential for tidal stream generation to make use of strong currents, particularly at the north and south ends of the Island. Energy could also be harnessed from the large tidal range experienced around the Island, either in free-standing or barrage devices (Appendix 17). Wave energy has lost some of its attraction recently due to the extreme environments it has to withstand, but ongoing developments may yet provide the required reliability. Geothermal power may also be available from deep drilling into thermal hotspots – a feasibility study would be useful. Heat exchangers provide a well-tried technology for extracting low-grade (space-heating) energy from rivers or sewage flows. Biogas generation from anaerobic digestion (Appendix 18) of biogenic wastes or energy crops, or even grass, is now becoming commonplace. The resulting biogas can be purified sufficiently to feed, for example, into the 7 smaller isolated gas grids on the Island (Appendix 19). Hydrogen generation from renewable power sources, for example offshore wind, provides a potentially very attractive method for storing intermittent excess power and then using it to fire electricity generation, for example in a modified Pulrose station, or even supply gas, through existing grids, to heat homes (Appendix 19). Some of these technologies are deployable now – for example digesters and heat exchangers – but most still face some technical and/or economic barriers to adoption. However, it is very likely that decisions can be made within some years to inform future deployment on the Island. It is suggested that appropriate calls be made for expressions of interest.

It is worthwhile to maintain a watching brief on other emerging technologies. One, for example, is the development of small modular nuclear reactors, potentially of value in supplying electricity baseload of 400MW (Appendix 20). These are at early-stage and would likely face considerable popular opposition on the Isle of Man and also certainly encounter major obstacles on radioactive waste management/disposal where international treaty obligations are very prescriptive. A reactor would very likely jeopardise the IoM Biosphere status. A second, and potentially more attractive proposition, is Direct Air Capture, a closed

loop chemical process that captures CO_2 direct from the atmosphere and, using renewable electricity, can then turn it into a synthetic fuel for powering vehicles or planes (Appendix 21). Although still in fairly early-stage development, commercial viability seems realistic.

g) Space Heating

Space heating is a major contributor to the IoM carbon emissions. Virtually all heating is currently derived, one way or other, from burning fossil fuels (Appendix 22 a, b). Natural gas and oil, split equally, are the predominant sources providing around 95% of heat, while LPG provides most of the remainder.

Heat pumps are now the cheapest heating appliance to run (5.49p per useful kWh), although the margin with oil heating (6.44 p per useful kWh) is small. Assuming average household consumption of 10,000 kWh then the running cost differential is £100 pa. So, there is almost no financial incentive to undertake the significant capital investment (assumed in Section 8.2 to be £7000 on average per property, under a large framework contract) and physical disruption to make the change-over from oil to heat pump, or indeed even to cheaper options such as wet electric boilers or modern storage heaters which are then more costly to run. The equivalent differential for gas heating might be around £400 pa, making the transition slightly more attractive.

However, the removal of fossil-fuelled heating systems is necessary (Appendix 22 a). The higher ambition pathway requires all oil-fired heating systems to be removed by 2030. This is because it is worth waiting until round about 2030 to make a decision, based on developing technology and cost, as to whether hydrogen generation can then substitute more readily for the remaining houses on the natural gas grid.

It must be assumed that oil-fired conversions will only be tolerated by householders if a direct and full grant is awarded. This has been estimated, as an average, of £7000 per house. This figure should be tested, because it is the biggest single outlay of public funding in the period up to 2030. The estimate is based on typical, albeit dropping, costs of air-source heat pumps and the expectation that a proportion of houses will not be suitable for heat pumps and will be fitted with much cheaper electric boilers or storage heaters.

Over the same period to 2030, the small isolated gas grids could be converted to biomethane generated in relatively small local plants, using biogenic wastes and energy crops as feedstock.

Around 2030, a decision must be made on the future of all other space heating which will, at that time, still remain on the natural gas grid.

h) Transport, Public Transport, Waste Transport

The target dates for banning the sale of fossil-fuelled vehicles range from 2025 in Norway, 2032 in Scotland and 2040 in the remainder of the UK. For the Isle of Man (Appendix 23), a policy target has already been set of 10,000 non-fossil vehicles to be registered by 2030, with decarbonisation by 2050 (note that this target of 10,000 is based on a scenario envisaging a $+2^{o}C$ world, therefore on the lower ambition pathway). In July 2019 there were only 277 electric vehicles on the island; there is much to do.

The transition to wide uptake of electric cars will need significant initial incentivisation but will, later, become self-perpetuating. The initial marketing will still need to be highly

persuasive since past financial incentives to purchase electric cars in the UK have not proved particularly successful. However, it is calculated that the lower running costs of electric vehicles, in terms of fuel and maintenance, mean that savings are currently made after 3 to 4 years. https://www.rac.co.uk/drive/advice/emissions/can-you-actually-save-money-going-electric-in-2018/ . This is not yet fully factored into purchasing decisions. Regarding emissions, it is already the case that an electric car emits around 40% less associated CO_2 than an equivalent petrol vehicle. Again, marketing is often not clear on these advantages.

All countries with high penetration of electric vehicles have certainly incentivised purchase by offering tax reductions or grants. For example, in Norway purchase tax was removed (25%) while other countries offered up to $10,000. Because of reducing prices and increasing confidence in, and cost-effectiveness of, electric vehicles, these subsidies are now declining. Private vehicles on the IoM tend to be retained for over 16 years, somewhat longer than in the UK, so some incentivisation will be necessary to speed up the transition to electric vehicles.

Private purchase of electric vehicles on the IoM will need to be subsidised for a period, before a ban is introduced on registration of fossil-fuelled vehicles, and a subsidy should also be offered for early-adopter installation of home charging points. Both these subsidies would be gradually withdrawn over the introductory period of, say, 10 years.

As suggested with respect to the elimination of oil-fired space heating (Section 10(g)) and the associated element in the recommended action plan (Section 13.1), there may be a need to increase either vehicle fuel duty or, perhaps more readily, annual fossil-fuelled vehicle tax in order to increasingly penalise those who are reluctant to change to electric vehicles. If a requirement for MoT was introduced, then it could be used to deliver a very simple road-pricing approach. A levy could be imposed on the basic MoT fee, calculated from vehicle emission and mileage covered in the previous year. This could easily be adjusted also to take account of address of registration so that those living in remoter parts, and dependent on a car, could be relieved of some of the charge. To cover the true externalities of motoring, the levy might range from zero up to £600 each year, initially bringing in around £10M and encouraging a shift to low, or zero, emission vehicles.

The cultural barriers to change could also be challenged by encouraging the provision of e-bikes and mobility-as-a-service through the likes of car sharing schemes.

The first step in reducing emissions from transport is to obviate the journey. This can be achieved for commuters by encouraging home-working or use of local drop-in business hubs (Appendix 24). The next-best option is to adopt active travel (see Section 10(j)), followed by use of public transport (Appendix 25 a).

Currently the Bus Vannin fleet complies with Euro VI standard for emissions so is relatively high performing particularly regarding polluting emissions, but much more will need to be done regarding carbon (Appendix 25 b). Attracting customers to use public transport is critically dependent on convenience, speed and reliability of service, making public transport the more attractive option must be the objective. From initial research it appears cost is generally of lesser importance than improving the service. Improving public awareness of services is regarded as an important factor. Provision of real-time information at bus stops is an effective solution. Simplifying tickets and fare structures also helps, while timetables should be created to maximise customer convenience. An integrated bus and rail strategy would bring together these options and provide a platform to explore other options that could be taken for higher ambition.

Bus Vannin has 72 buses in operation, providing a good service between main towns, and is trialling hybrid vehicles. While the future of the dominant power-train for heavy vehicles remains a little doubtful, it is clear that complete de-carbonisation must be the objective, even in the short-term. Major manufacturers are promoting electric buses which have already captured 9% of the market, have a range between 100km and 250km, and whole-life costs which are very close to those of traditional buses. https://www.transportenvironment.org/sites/te/files/publications/Electric%20buses%20arrive%20on%20time.pdf

The Government fleet totals 1,200 vehicles of which 24 are electric. Around 80 vehicles are replaced each year. The purchase cost of electric vehicles may remain slightly higher for a while yet, but life-time costs are already lower than traditional vehicles. Government must take a proactive approach and be seen to set the example and lead the transition to low-carbon transport. Ambition in this area will also accelerate the provision of charging infrastructure (Appendix 26). It is clear that all new-build developments must include adequate charging provision. For provision of charging points in public areas, it may well be preferable to call for expressions of interest in commercial contracts.

In the higher ambition scenario (section13.1), it is proposed that all public vehicles should be electrified by 2035.

The statutory collection of kerbside waste across 17 areas suffers from limited integration and common standards (Appendix 13 c). Of the 21 refuse collection vehicles, only 7 are of modern emissions standards. There are no reliable data on numbers or lengths of journeys undertaken which is concerning, given that increased recycling will, almost inevitably, further increase the number of journeys required. It is clear that centralised optimisation of logistics and vehicle performance is urgently needed.

i) Active Travel

There has been an increase in use of the private car for transport on the Isle of Man since the 1990s, although that upward trend has now stabilised (Appendix 27). This runs contrary to several principles of sustainability. However, it will take concerted effort to change behaviours; those efforts should, initially at least, be focussed on incentivising other forms of transport and providing the facilities and infrastructure to make it easy, and indeed preferable, to adopt more sustainable behaviours, including use of public transport and participation in active travel (walking, cycling).

Despite a slight increase in active travel between 2016 and 2017 for commuting to work, this has apparently been at the expense of use of public transport and car-sharing. The barriers to active travel include distance, weather, safety, facilities, lack of available routes, and cost of equipment.

There are already many strategies, policies and measures that promote more sustainable travel. A public consultation in 2017 revealed a very favourable opinion (82%) in favour of cycling and walking being normal and realistic choices, and this forms the vision of the current active travel strategy. Recommended actions were varied but included increased awareness and improved infrastructure. The target is to double, to 30%, those adopting active travel by 2030 compared to 2011. This target appears stretching and will need strong support in terms of investment in segregated pathways and cycleways, and robust application of planning guidance in ensuring that new developments have easy access to public transport and active travel routes to reach services. There is synergy with the

provision of drop-in business hubs (Appendix 24) to encourage remote-working and reducing longer-distance commuting. Such provision will encourage active travel across the whole Island and not just around Douglas.

j) Agriculture, Local Produce, Marketing

It is known that 75% of the Isle of Man land area is used for agricultural production. This sector therefore has a very important role to play in minimising carbon emissions and in maximising carbon sequestration (Appendix 18). Agriculture has economic, social and cultural importance on the Island. Self-sufficiency of food is a key concept and can potentially reduce food miles and food waste, thereby contributing to reduced carbon emissions.

The greatest contribution to emissions arises from methane from livestock, predominantly beef, sheep and dairy, both directly and through manure management.

Currently there are only penalties associated with poor environmental practices, rather than rewards for improvements, either generally or specifically related to climate change mitigation. Consideration of a new agriculture strategy is ongoing and seeks to address this imbalance.

There are many options for a more efficient, productive and remunerative agricultural sector which can provide useful carbon benefits:

- Reduced soil tillage: could be advantageous in targeted areas. Also known as direct drilling, this technique obviates ploughing which aerates large areas of soil which then oxidise and release CO_2
- Avoidance of soil compaction: often as a result of movement of machinery in wet conditions, compaction can lead to increased release of nitrous oxide N_2O, a very powerful greenhouse gas
- Planting winter cover crops: can increase valuable carbon input to the soil and reduce N_2O emissions. Nitrogen-fixing crops can improve soil fertility and reduce the costs and emissions of using artificial fertilisers
- Soil management: based on good analysis of pH and nutrient levels, soil biodiversity can be enhanced which improves soil condition, fertility, productivity, soil retention, and sequestration
- Fertiliser application: precise and minimised fertiliser application saves money and reduces greenhouse gas emissions
- Managed farm wastes: slurry and farmyard manure are sources of methane CH_4 and nitrous oxide N_2O. They need careful management to minimise climate impacts by, for example, injection to soils rather than spreading, covering of slurry stores and tanks, possible acidification of slurry. Farm wastes can also feed anaerobic digestors.
- Liming: possible use of local sea-shells would create new business opportunities and reduce transportation
- Livestock feed: modifications to feed and feeding regimes can reduce enteric emissions and therefore methane CH_4
- Increased livestock health & fertility: appropriate measures can reduce the total numbers of livestock required to satisfy a specified market.

Agroforestry entails the integration of trees with conventional farming practices. It provides some benefits to livestock management and productivity in terms of shelter in both winter and summer, and can also generate some additional income. Trees, of course, sequester significant carbon.

The cultivation of energy crops, supplemented by other crop-residues, can provide further diversification of farm incomes by supplying feedstock for anaerobic digestors which might, potentially, generate a low-carbon gas supply for parts of the Island (See section 10(f)(v)).

It is anticipated that health advice will continue to depress sales of meat, and particularly red meat (Appendix 4). There is already evidence of shifting dietary habits, particularly among the young https://www.thegrocer.co.uk/future-of-meat/what-uk-shoppers-think-about-meat-free-and-plant-based-in-12-charts/568844.article. This trend should therefore be accommodated within the future vision of more diverse farming production on the Island, providing a wider selection of fruit, vegetables and cereals, as well as fibre crops, and energy crops. In contrast, it should be recognised that, at the moment, meat consumption is increasing in developing countries as they become more affluent.

The new, disruptive technology of vertical farming (Appendix 28) should be considered on the IoM as it works particularly well with high penetration of renewable electricity supply and a local market which is at a disadvantage for fresh, high-value, products due to the need to import. Local community gardens can also play a part.

The Food Matters Strategy emphasises many of these points and argues for food security, greater supply of the local market and diversification of products.
https://www.gov.im/media/1346122/food-matters-document.pdf

One avenue to be explored is the opportunity for the Manx agricultural sector to work collaboratively to harvest, store and distribute its diversifying produce directly to customers on the Island, thereby enhancing its authentic provenance, its brand value, and at the same time reducing food waste and food miles (Appendix 29). The short-lived success of the Isle of Man Food Assembly offers a positive story of market potential. The Island's Food & Drink Festival also substantiates the interest in buying local.

A revision of the Agriculture Development Scheme needs to consider the value of all these opportunities for financial support.

k) Commercial, Industrial, Waste, Circular Economy

There is currently little information on the composition and sources of greenhouse gases emitted by businesses and industry on the Isle of Man. The official returns are, for the most part, based on *pro rata* calculations. Before actions can be identified, much more detailed evidence is required.

The Chamber of Commerce has recently inaugurated a Climate Change Committee and a necessary first step would be to work with them to visit all Island businesses and populate a more definitive inventory and, at the same time, to encourage businesses to support the new Committee and develop individual carbon-reduction plans. The available grants from the Department for Enterprise should be reviewed to give immediate financial support, both to the data gathering and also to any necessary subsequent action plans.

The model of a circular economy is developing rapidly (Appendix 30). It will form the basis of the next industrial revolution and opportunities for developing the concept on the Isle of

Man should be explored with the business and investment community. Due to its potential beneficial impact on reduction in use of raw materials and promotion of good design, incorporating repairability, upgradeability, disassembly, and reuse and recycling, this approach delivers a higher productivity, higher GDP, and higher employment economy. In addition, it has been estimated that a circular economy in Scotland would provide a 20% reduction in territorial carbon emissions.

https://www.zerowastescotland.org.uk/sites/default/files/CIoCE%20Technical%20Report%20-%20FINAL%20-%2015.06.15.pdf

A manifestation of the move towards a circular economy is the wide public concern regarding single-use plastic (Appendix 31). The IoM single-use plastic reduction plan and Directives from Europe suggest a rapid decline in its usage in commercial products. Actually, this indicates how societal concern can instigate very rapid change, and the same is now needed across the spectrum of climate change mitigation. Although an entirely sensible measure in global terms, its impact will be limited in local terms since the IoM does not support its own indigenous and comprehensive recycling capability, due to limited through-put, and a lot of plastic waste is included in feedstock to the energy-from-waste plant at Richmond Hill.

l) Blue Carbon

Blue carbon refers to the ability of marine ecosystems to absorb and store, or sequester, atmospheric CO_2 (Appendix 10 b). These systems can be far more effective than land-based systems, sometimes sequestering up to 5x faster than equivalent land-based areas. The entire Manx sea area may sequester up to 25% of the Isle of Man territorial emissions, but this process is not recognised in the UNFCCC carbon accounting methodology. Only sequestration by saltmarsh and seagrass (also mangrove, but not relevant here) can be claimed. This is a factor that should be included in future IoM submissions, even though it is currently very small. For those carbon sequestration pathways, not yet recognised by the international accounting body, there may still be opportunities for them to be included in voluntary offsetting schemes (see Section 10(b)). Further opportunities to use marine biomass (*eg* kelp) as a sustainable biofuel and/or natural soil fertiliser and carbon-enhancer should be further explored.

It would be advisable to adopt a Manx marine action plan to integrate carbon management with the many other ecosystem services which this important zone offers to an Island nation.

m) Other Actions

i) Procurement

The IoM Government should show leadership in delivering climate emission reductions. One route by which this can be rapidly demonstrated is to ensure all public procurement actions address carbon implications (Appendix 32). Procurement guidance should be revised to place appropriate emphasis on climate impact.

ii) Shipping

The carbon emissions from ferry transport are split equally between the IoM and the UK for reporting in the carbon account. A first-step would be to carefully scrutinise operation of the fleet with a carbon-efficiency perspective (Appendix 33 a, b, c). It appears there is currently

significant over-capacity due to timetabling arrangements; fewer journeys would generate fewer emissions.

There is ongoing research to create new low-carbon fuels for shipping, particularly biofuels, hydrogen or electric propulsion. At the moment, none is sufficiently advanced to be a low-risk option for a lifeline ferry that takes significant cargo, over a long distance of 40 nm, and sometimes in severe weather. A new Ro-Pax vessel is being commissioned (Appendix 33 b) to be in operation by the end of 2022, and it will be required to be able to operate with either marine fuel oil or liquified natural gas (LNG) – however, LNG offers only limited carbon reductions and, in any case, there is no LNG bunkering facility available on the route. Biodiesel presents an opportunity for the future. At the moment fuel cost is approaching double that of traditional marine fuel oil, and there are doubts about the availability of plentiful, sustainable, supplies in future. By the time a new high-speed ferry is commissioned for operation in 2026, there may be more options available.

There is limited opportunity for taking any direct action to reduce emissions from cruise ships (Appendix 33 c) but they could be asked, voluntarily, to subscribe to an IoM offsetting scheme (See section 10(b)) so that they operate with carbon-neutrality while in Manx waters.

iii) Aviation

The carbon emissions from domestic flights are split equally between the IoM and the UK for reporting in the carbon account.

Aviation suffers the same intractability of emissions as shipping (Appendix 33 a). Currently small amounts of biodiesel can be mixed with kerosene to fuel aircraft, but there are technical limitations. Electric aeroplanes are under development with the first commercial sales expected in 2022 of a small craft, taking up to 10 passengers, being capable of flying for 600 miles. So, there may well be some future scope for use of such craft on short-haul flights to destinations in the UK and Ireland.

Emissions trading is applied to all intra-EEA flights https://ec.europa.eu/clima/policies/transport/aviation_en and this obligation is being extended while a global arrangement (CORSIA) is introduced. From 2021 all EU countries will join the scheme. This scheme has the limited aim of stabilising aviation emissions at 2020 levels by requiring offsetting of any future growth. This offsetting seems likely to be of UNFCCC approved status, so that those emissions will not appear in territorial carbon accounts.

iv) Planning System, Building Regulations

The land-use planning system has a huge role to play in both climate change mitigation and adaptation. Planning policy is concerned with achieving an appropriate balance between the development needs of the Island and the environment. Currently the IoM has adopted (Appendix 34) a principle of “no net loss for biodiversity”. This is a good starting point, but with the recognition of a climate emergency, there should be a stronger statement embedded in planning legislation. The current English environment bill is more proactive and proposes a mandatory element in planning legislation to deliver measurable net-gain of biodiversity. However, even this may be regarded as potentially inadequate. Better would be a principle of net-gain to all ecosystem services. One of the principal ecosystem services is, of course, carbon sequestration which would therefore have to be demonstrably enhanced in any development. The other elements of ecosystem services include: culture, food and water supply, recreation, habitat provision, and genetic preservation. https://biodiversity.europa.eu/topics/ecosystem-services

Under the Building Regulations, the Standard Assessment Procedure, a measure of energy efficiency, is being introduced and there will be a requirement for new-build to achieve a high rating of SAP 97 by 2027 (Appendix 34).

v) Sustainable Drainage Systems (SuDS)

Sustainable management of surface water (Appendix 35) provides many benefits: reduced damage to property and environment, higher amenity, reduced costs and, additionally, reduced carbon emissions and sequestration of carbon. SuDS, and wider green infrastructure measures, are ideally planned at the earliest stage of any development, but can also, in many cases, be retrofitted. The practice on the Isle of Man to ensure there is no excessive surface water runoff from a developed site can result in underground storage tanks being constructed - for retention of water from parking areas, roofs and roads. Much preferable is to provide opportunity for water to infiltrate naturally, or to be held in ponds and wetlands, and to be retained by wet woodlands https://www.confor.org.uk/media/246067/confor-37_forestryandfloodingreportfeb2016.pdf. Such systems also offer natural self-purification of pollution, and reduced flows to sewage works, thereby reducing the pumping and treatment required, and therefore the energy consumption and ultimately the associated carbon emissions. Green SuDS infrastructure, such as green roofs, swales, ponds and wetlands, also encourage biodiversity and the ecosystem service of natural carbon sequestration, often by trapping carbon-rich sediments.

https://curve.coventry.ac.uk/open/file/eb9002e3-b001-251a-ced5-b20c5641dafc/1/A%20review%20of%20the%20adaption%20and%20mitigation.pdf

The Government's planning system should align and support SuDS policy, while wider catchment management in support of SuDS could be supported through mechanisms such as the Agricultural Development Scheme.

vi) Climate Change Adaptation

The Nationally Determined Contributions (NDCs), or promises, under the UN Paris Agreement are, so far, very inadequate to confront the challenge of climate change. They provide only sufficient reductions in emissions that would result in a +3^{o}C global temperature rise by 2100, with continuing increases beyond https://www.unenvironment.org/resources/emissions-gap-report-2018 . There will, almost certainly, be further national commitments under the Paris ratcheting scheme and it is, therefore, to be expected that eventual warming may be less. But, in any case, the planet has already warmed by +1^{o}C, and parts by much more, and further warming is inevitable. The Isle of Man will not be insulated from the resulting global storms, droughts, floods, rising sea-levels, wildfires, heatwaves, extinctions, outbreaks of pests and diseases, social unrest, mass migrations, disruption to supply chains and commodity price volatility. This may seem apocalyptic - but positive outcomes will be rare, negative outcomes very common. It is important that the Isle of Man reviews all its risks and vulnerabilities, the potential negative and positive impacts, the costs and benefits, and develops a strategy and action plan to provide resilience. It would be wise to consider a climate change adaptation bill, as well as a climate change mitigation bill. They could be combined, but only if the latter is not thereby delayed.

vii) Development of Potential Gas Field

While this report was being written, public discussion arose concerning the possible development of a natural gas field at the eastern edge of Manx territorial waters. As explained in Section 5.2, the supply of gas does not form part of the UNFCCC accounting for

territorial emissions. It is the user, not the supplier, of gas that is held accountable. The use of any extracted gas, *per se*, does not fall within the remit of this report. However, it is worth noting that gas extraction, processing and distribution leads to some direct CO_2e emissions including venting or leakage of a constituent, methane CH_4, which is a powerful greenhouse gas. Its warming potential, according to the UNFCCC, being 25x that of CO_2. Given the scale and rate at which gas may be produced from the offshore field, it is possible that an increment of around 7% to 8% (of 2010 baseline) may be attributable to the Isle of Man CO_2e emissions account. The quoted UK equivalent is 3% https://oilandgasuk.co.uk/wp-content/uploads/2019/05/OGUK-Environment-Report-2018.pdf. So, there is some uncertainty and any outcome would be dependent on specific and unknown commercial decisions. This IoM attribution could arise as early as 2025, and could last beyond 2050, dependent on any licence arrangements. This emphasises, of course, the need to ensure good on-site management and tight regulation. In addition, it serves to reinforce the value of maximising natural sequestration which could potentially balance this, and other, future, hard-to-avoid emissions. This sequestration would comprise enhancement of woodlands/peatlands (Section 10(d)) and potentially of blue carbon (Section 10(l)), even though it hasn't yet been fully accepted in the UNFCCC methodology.

n) Funding Possibilities

It has been shown that significant public and private funding will be required, from around 2021 onwards, in order to deliver all the climate change mitigation actions. It has been estimated, subject to future substantiation, that around £25M per year will be required from each of the public and the private sectors for delivery of the higher ambition pathway.

It would be potentially advantageous if the IoM private financial sector could develop a profile for green or sustainable investment to support, facilitate and maybe fast-track, the necessary private investment. However, the structure of the IoM financial sector seems to obviate such a specialism. However, for the major investments which will be required, currently being some commercial forestry, onshore solar and wind generation and, in the near future, offshore wind generation and electric vehicle charging networks, then there should be no lack of wider interest. At a later stage, assuming commercial viability, then the same should be equally true of potential investment opportunities in anaerobic gas production, tidal stream generation, and a hydrogen supply service.

Public funding will no doubt be required to stimulate improved energy efficiency in buildings and for subsidies for early purchase of electric vehicles, early installation of domestic charging facilities, and for conversion of fossil-fuelled heating systems. There appears little opportunity to use funds held in the IoM Government reserves - since these are either for predicated purposes or serve as investment vehicles to cover ongoing expenditure. There appears also to be little opportunity for the issuing of sovereign bonds, or green or climate bonds, since this may adversely affect national credit rating.

So, in view of the possible costs of climate action, Government should usefully seek creative and innovative approaches to attract supportive private investment. One way might be through consideration of setting up an "IOM Biosphere" Equity Fund – a form of managed strategic investment fund.

A review of potential new tax or duty revenues found little scope (Appendix 36 a, b), certainly without negotiation with the UK and subsequent legislation, for significant change - although

this could be further explored if necessary. One suggestion could include some form of levy on carbon emissions which could then be ring-fenced for projects where the largest reductions in CO_2 can be delivered (Appendix 36 b iii); alternatively, an analogous carbon reduction commitment (CRC), as previously practised in the UK, might be worth pursuing if the commercial/industrial sector is laggardly. The scheme within the UK was criticised for being overly complex and costly to run and has recently closed, so a much simpler version would be advisable. Ultimately it is, of course, a political decision on how public income should be acquired and expenditure distributed.

11. Knowledge gaps

As the evidence-gathering for this report has progressed, the Analytical Team has noted evidence gaps (Appendix 37). This listing should act as a resource on which to base potential external research portfolios in universities, colleges or schools. There may also be opportunities to tackle some issues using citizen science – an ideal vehicle to involve and motivate wider civic society (https://www.citizenscience.org/) and already a popular feature on the Island (Manx whale, dolphin and basking shark watches, and several others). Undoubtedly some evidence gaps will require either internal investigation or commissioning of external consultancies.

12. Acknowledgements

The Analytical Team, creating this report's evidence base, has worked well beyond normal expectations and each member (Appendix 6) deserves great credit for their commitment and dedication, often researching topics beyond their immediate expertise and repeatedly meeting extremely tight deadlines. In addition, tribute must be paid to the many other politicians, Government and Agency staff, and external organisations, civic groups, and individuals who have offered constructive challenge and new insights and ideas (Appendix 4).

13. Timeline of Actions

Actions can be laid out in some detail for the first 3 years, 2020 to 2023, and with reasonable certainty for the following years until 2030. Beyond ten years ahead, there will arise some fundamental questions. By then, there should be sufficient evidence on which to base decisions: for example, on whether tidal stream energy generation is operationally reliable and cost-effective, and on whether hydrogen generation by electrolysis has become commercially competitive. For this reason, actions beyond 2030 are much more speculative.

Timelines are presented for the recommended higher ambition pathway (Section 13.1) and also for the lower ambition pathway (Section 13.2). Ordering of actions is not precise, and position against the timeline is not precise. A formalised programme (Section 9) would need, as an early requirement, to provide greater certainty and structure. Opportunities should always be taken if any action can, practicably, be initiated earlier and accelerated faster towards completion.

The action tables are presented at a level of detail, and in a style, that might be expected by the programme executive board, as suggested in Section 9. The formal programme would, of course, develop more detailed Gantt charts, milestones and targets, as well as assess

interdependencies and risks and risk mitigations. There are many, subsidiary, or supporting recommendations and proposals in this report that don't appear either in the tables in Section 13.1 or 13.2, or in the list of recommendations in Section 14 – they should not be ignored but should be pursued by the project boards, as also suggested in Section 9.

It is important to emphasise that there are risks in selecting individual actions in any of the tables of Sections 13.1 and 13.2, either for delay or for deletion. There are numerous interdependencies and the consequences of re-sequencing would need to be considered carefully. Although early start and acceleration of individual actions is to be encouraged, there may also be certain preconditions that need to be fulfilled.

13.1 Higher ambition actions

Higher Ambition: Time-lined action list 2020 - 2023		
Period	**Action**	**Suggested target**
Start 2020	Awareness campaigning and building collaborations	2023: 80% population understand action plan
	Climate Change Bill	2020: Introduced to Tynwald
	Create governance structures & reporting cycles	2020: structures in place
	Determine more robust costs and expenditure profile	2020: report published
	Ensure low-carbon options considered, if not too late, in plans for dock & ferries as well as operations	2020: specifications allow flexibility
	Improve emissions data for business and agriculture sectors	2020: report published, jointly with Chamber of Commerce/MNFU
	Launch a local offsetting scheme	2020: Website operational
	Start peatland restoration (9000 ha)	All complete by end 2028
	Start woodland planting (6000 ha)	All complete by end 2028
	Model future electricity grid requirements	2021: report published
	Provide planning advice on ecosystem service gain	2021: planning advice published
	Develop a SuDS policy	2021: policy agreed and published
	Publish a re-skilling strategy and action plan for a green economy	2021: agreed and published
to	Introduce a single-use plastics ban	2021: in force
	Launch domestic energy-efficiency scheme	Start 2021: all properties surveyed and >80% uptake by 2030
	Revise MUA practices to encourage diversified generation – may require legislation	2021: new protocols agreed
	Call for expressions of interest for provision of onshore wind & solar capacity (150MW & 50MW)	2021: provider selected. In place by 2025
	Feasibility + call for expressions of interest in geothermal energy	2021: providers selected
	Announce end date for registration of fossil-fuelled vehicles (perhaps 2030)	2021: announcement made
	Announce future road tax requirements	2021: announcement. 2024: in place
	Launch time-limited subsidy scheme for electric vehicle purchase	Start 2021. By 2030 will be 20,000 vehicles
	Map habitat connectivity opportunities	2022: map published and

		informing biodiversity strategy. 2023: action programme underway
	Increase active travel in all locations; strengthen planning guidance	2021: investment begins. 2023: active travel in Douglas achieves 30%
	Agri development scheme includes agri-forestry, produce diversification, innovation in livestock management, precision agriculture, energy generation, direct marketing to customers	2023: high uptake across all factors
	Climate change in curriculum in schools	2023: >80% students accessing climate change opportunities in various subjects
	Research programme to fill evidence gaps	2023: >80% evidence gaps either filled or progress underway
End 2023	Promote public transport	2025: increase of 20% in passenger numbers

Higher Ambition: Time-lined action list 2023 - 2030		
Period	**Action**	**Suggested target**
Start 2023	First action plan review	Published 2023, then every 5 years
	Review Dept for Enterprise business support schemes to promote energy/resource efficiency	2023: new schemes announced
	Enhance blue-carbon assets; deliver a marine management plan	2023: plan published. Sequestration increased 10% by 2030
	Launch subsidy scheme to replace oil-fired heating	>95% premises completed by 2030
	Circular economy bill	2023: in Tynwald
	Climate adaptation bill	2023: in Tynwald
	Call for expressions of interest in offshore wind generation	2023: providers selected. By 2028 generation starting
	Complete grid strengthening and smart grid management, including battery storage	2024: in place to receive renewables & provide demand management
	Onshore renewable generation starts	2025: wind & solar comes online (150MW/50MW)
	Encourage distributed energy generation	2025: >1000 applications from individual properties
	Call for expressions of interest in vehicle charging network	2024: contract in place
	Heat from energy-from-waste plant now utilised	2025: heat recovery system opened
	Consider legislation for oil-fuel levy if oil-heated property conversions are stalling, and increase vehicle tax for fossil-fuelled vehicles if progress is slow	2024: assess and decide
	Electrification of public vehicles	2025: all complete
	Diesel power station running on biodiesel, or decision to decommission	2025: conversion or set decommission date
	Create strategic drop-in business hubs	2025: two centres open
	Non-intensive planting of trees on rough grazing land	2028: complete
	First offshore wind generation with supply contracts in place, possibly also geothermal	2028: supply to IoM grid
End 2030	Oil heating replaced	Programme complete by 2030
	45% reduction in emissions achieved	

Higher Ambition: Time-lined action list 2030 - 2050		
Period	**Action**	**Suggested target**
Start 2030	Review and decide on feasibility of hydrogen production by hydrolysis	Decision by 2031
	Commission biomethane plants for isolated gas grids	2035: operational
	Decide on recommission or decommission of Pulrose CCGT station:	Decision by 2032. Action begins by 2035
	After review, call for expressions of interest in tidal generation	Call in 2031
	Review and decide on space heating for gas-fired premises: feed hydrogen into main grid, or convert to electrically-powered heating	Decision in 2032
	Launch subsidy scheme for gas space heating conversions	Scheme operational from 2033
	Call for expressions of interest, if appropriate, in tidal generation and hydrogen generation	Call in 2033
	All fossil-fuelled heating removed	Programme complete by 2045
	Offshore wind generation at maximum potential (several GW), supplying IoM and exporting	Development programme complete by 2050
	All vehicles electrical	By 2045
End 2050	**Net-zero achieved**	

13.2 Lower ambition actions

Lower Ambition: Time-lined action list 2020 - 2023		
Period	**Action**	**Suggested target**
Start 2020	Awareness campaigning and building collaborations	2023: 60% population understand action plan
	Climate Change Bill	2020: Introduced to Tynwald
	Create governance structures & reporting cycles	2020: structures in place
	Determine more robust costs and expenditure profile	2021: report published
	Ensure low-carbon options considered, if not too late, in plans for port & ferries as well as operations	2020: specifications allow flexibility
	Improve emissions data for business and agriculture sectors	2021: report published, jointly with Chamber of Commerce/MNFU
	Launch a local offsetting scheme	2021: Website operational
	Start peatland restoration (4500 ha)	All complete by end 2035
	Start woodland planting (3000 ha)	All complete by end 2035
	Model future electricity grid requirements	2022: report published
	Provide planning advice on ecosystem service gain	2022: planning advice published
	Develop a SuDS policy	2022: policy agreed and published
	Publish a re-skilling strategy and action plan for a green economy	2022: agreed and published
to	Introduce a single-use plastics ban	2022: In force
	Launch domestic energy-efficiency scheme	Start 2022: all properties surveyed and 50% uptake by 2030
	Revise MUA practices to encourage diversified generation – may require legislation	2022: new protocols agreed
	Call for expressions of interest for provision of onshore wind & solar capacity (100MW & 25MW)	2021: provider selected. In place by 2028
	Feasibility + call for expressions of interest in geothermal energy	2022: providers selected
	Announce end date for registration of fossil-fuelled vehicles (perhaps 2035)	2023: announcement made
	Announce future road tax requirements	2023: announcement. 2026: in place
	Launch time-limited subsidy scheme for electric vehicle purchase	Start 2023. By 2030 will be 10,000 vehicles
	Map habitat connectivity opportunities	2023: map published and informing biodiversity strategy. 2024: action programme underway
	Increase active travel in all locations; strengthen planning guidance	2023: investment begins. 2026: active travel in Douglas achieves 30%
	Agri development scheme includes agri-forestry, produce diversification, innovation in livestock management, precision agriculture, energy generation, direct marketing to customers	2025: high uptake across all factors
	Climate change in curriculum in schools	2025: >80% students

		accessing climate change opportunities in various subjects
	Research programme to fill evidence gaps	2024: >80% evidence gaps either filled or progress underway
End 2023	Promote public transport	2027: increase of 20% in passenger numbers

Lower Ambition: Time-lined action list 2023 - 2030		
Period	**Action**	**Suggested target**
Start 2023	First action plan review	Published 2023, then every 5 years
	Review Dept for Enterprise business support schemes to promote energy/resource efficiency	2023: new schemes announced
	Enhance blue-carbon assets; deliver a marine management plan	2023: plan published. Sequestration increased 5% by 2030
	Launch subsidy scheme to replace oil-fired heating	50% premises completed by 2030
	Circular economy bill	2025: in Tynwald
	Climate adaptation bill	2025: in Tynwald
	Call for expressions of interest in offshore wind generation	2023: providers selected. By 2030 generation starting
	Complete grid strengthening and smart grid management, including battery storage	2024: in place to receive renewables & provide demand management
	Onshore renewable generation starts	2025: wind & solar comes online (100MW/25MW)
	Encourage distributed energy generation	2025: >500 applications from individual properties
	Call for expressions of interest in vehicle charging network	2024: contract in place
	Heat from energy-from-waste plant now utilised	2025: heat recovery system opened
	Consider legislation for oil-fuel levy if oil-heated property conversions are stalling and increase vehicle tax for fossil-fuelled vehicles if progress is slow	2026: assess and decide
	Electrification of public vehicles	2028: all complete
	Diesel power station running on biodiesel, or decision to decommission	2028: conversion or set decommission date
	Create strategic drop-in business hubs	2028: two centres open
	Non-intensive planting of trees on rough grazing land	2030: half complete, all complete 2035
	First offshore wind generation with supply contracts in place, possibly also geothermal	2030: supply to IoM grid
End 2030	Oil heating replaced	Programme 50% complete by 2030
	25% reduction in emissions achieved	

Lower Ambition: Time-lined action list 2030 - 2050		
Period	**Action**	**Suggested target**
Start 2030	Review and decide on feasibility of hydrogen production by hydrolysis	Decision by 2031
	Commission biomethane plants for isolated gas grids	2035: operational
	Decide on recommission or decommission of Pulrose CCGT station:	Decision by 2032. Action begins by 2035
	After review, call for expressions of interest in tidal generation	Call in 2032
	Review and decide on space heating for gas-fired premises: feed hydrogen into main grid, or convert to electrically-powered heating	Decision in 2032
	Launch subsidy scheme for gas space heating conversions	Scheme operational from 2033
	Call for expressions of interest, if appropriate, in tidal generation and hydrogen generation	Call in 2033
	Oil-fired space heating conversions complete	By 2040
	All fossil-fuelled heating removed	Programme complete by 2047
	Offshore wind generation at maximum potential (several GW), supplying IoM and exporting	Development programme complete by 2050
	All vehicles electrical	By 2048
End 2050	**Net-zero achieved**	

13.3 Comment on action timelines

From the tables in section 3.1, it can be seen that the higher ambition action timeline, in the absence of any slippage or unforeseen obstacles, can potentially deliver a net-zero position slightly in advance of 2050, perhaps even by 2045. It is not recommended to set a more demanding target - but to use the potential headroom to provide some surety that the 2050 target will be achieved.

In contrast, the lower ambition action timeline certainly provides a slower and less demanding start but, as shown in Section 8.1, actually requires faster action in the latter part of the 30-year period. There appears to be very little headroom in this timeline for slippage or for unexpected problems.

For this reason, once again, the higher ambition pathway is recommended.

14. List of Recommendations

1. A higher ambition pathway should be adopted, meeting 45% reduction in net-emissions in 2030, and attaining net-zero in 2050 (Section 8.1)
2. An associated higher ambition action plan be adopted (Section 13.1)
3. Consideration be given to allocating an annual Government budget of £25M (Section 8.2)
4. An ecological emergency should also be recognised (Section 2.4)
5. Formal programme governance and management practices be adopted for ensuring delivery (Section 9)
6. Just Transition be a principle of the action plan (Section 5)
7. Few targets should be set against carbon emissions; programme management is better served by setting targets against deliverable actions (Section 5.2)
8. The action plan should be reviewed in 2023 and, thereafter, every five years (Section 10(a)).

15. Reflections

This report, its recommendations and actions are all intended to provide a template which is useful to the Isle of Man Government, to Tynwald, to stakeholders and to communities throughout the Isle of Man. The intention is that the material can readily and rapidly be translated into a structured management programme to deliver the necessary actions across the next 30 years. There is no time to lose. Climate change is progressing rapidly and we must overtake it in our response.

END

Climate Emergency Consultative Transformation Team Terms of Reference (as agreed by Council of Ministers 27/06/2019)

1. PURPOSE

1.1. To develop the Isle of Man climate change action plan and target options for achieving net zero carbon emissions to lay before Tynwald in January 2020 and inform the subsequent Climate Change Bill.

2. BACKGROUND

2.1. In May 2019 the Chief Minister announced the development of a Climate Change Bill to be presented to Tynwald in the next legislative year. The Chief Minister outlined that the Climate Change Bill will commit this government and future administrations to reach net-zero carbon emissions by 2050 in line with the United Nations Intergovernmental Panel on Climate Change report. The Chief Minister also specified that the Bill will be accompanied by an action plan outlining key objectives to achieve that aim. The Chief Minister stated that the government recognises the climate emergency that is facing the planet, and is committed to acting on this: "We are not about words, we are about the actions that we take and we will work with Tynwald members, the public and interested groups to put in place a comprehensive action plan to reach this achievable target."

2.2. Following the Chief Minister's statement, in June 2019 Tynwald recognised the climate change emergency and committed to immediate action and called "on the Council of Ministers to set up a dedicated climate emergency transformation team, led by an independent Chair with relevant expertise, to develop the climate change action plan to include ambitious target options for achieving net zero emissions with interim targets and a climate impact assessment of proposals; in order to inform any statutory target obligations included in the proposed Climate Change Bi// being introduced in the next legislative year; and calls upon the Government to /ay its Climate Change Action Plan before Tynwald by January 2020."

2.3. This document provides the Terms of Reference for that dedicated climate emergency transformation team.

3. GOVERNANCE

3.1. The Climate Emergency Consultative Transformation Team (CECTT) will be led by an independent Chair (see Appendix 1 for Person Specification) who will direct the production of the climate change action plan and will have full editorial rights over the final plan that will be provided to the Council of Ministers. The role of this Team is to support the gathering of evidence and the engagement of stakeholders to assist the Independent Chair in the production of their report.

3.2. The Chair will be supported by the Climate Change Sponsor Group (CCSG), which will be responsible for advising on the strategic approach as recommended by the Emergency Transformation Team. The CCSG will report to Council of Ministers monthly.

3.3. The decision making in the CCSG will normally be by consensus, however, in the event of a vote;

- Political Members and chair have voting powers
- Independent Chair has casting vote

3.4. The CECTT is not a Committee — and no quorum is required. The Independent Chair's decision is final.

3.5. The CECTT has no authority to contract out work and no finance is allocated. Such contracts would be agreed by the Strategic Board and undertaken on behalf of the CECTT by Treasury, to be drawn from a new fund to be made available for this purpose.

4. MEMBERSHIP

4.1. Climate Change Sponsor Group membership shall comprise:

- Independent Chair (as Chair of Board)
- Ministers for Treasury, DOI and DEFA, plus respective CEOs
- Senior officer from Department for Enterprise
- Chief Secretary
- Communications Officer

4.2. Climate Emergency Consultative Transformation Team membership shall comprise, subject to the views of the Independent Chair:

- Independent Chair (as Chair of Board)
- Political Members — Mr Peake MHK and Mrs Poole-Wilson MLC.
- Climate science advisor(s) — contractors — to be agreed with Independent Chair Secretariat — DEFA Climate Change team
- CEO DEFA
- Communications Officer
- Officers representing each government department as required

4.3. The input of other relevant officers, the third sector and other stakeholders may be sought, as is considered relevant by the Independent Chair.

5. MEETINGS AND MINUTES

5.1. Meetings of the two groups will be called by the Chair.

5.2. Secretariat will be provided by DEFA.

5.3. Minutes will be routinely distributed to Council Of Ministers for circulation.

5.4. Minutes taken will be prepared in accordance with Minute Taking Guidance prepared by the Cabinet Office.

5.5. All documentation issued in relation to the CECTT (including terms of reference, proceedings and papers are subject to the same statutory confidentiality as applies to the meetings and proceedings of the Council of Ministers) and should be therefore treated accordingly, unless agreement is given.

5.6. Documents should not be circulated for wider distribution — [other than to officers and members of Council Of Ministers and E&I] — without first seeking the necessary permission of the Chair.

6. REPORTING

6.1. The Climate Emergency Consultative Transformation Team will provide an update to Council Of Ministers as a standing agenda item.

6.2. A progress report will be submitted to the E&I Committee and to the Council of Ministers within 4 months of the appointment of the independent Chair.

6.3. The Climate Change Action Plan will be submitted to the E&I Committee and Council of Ministers prior to the final plan being laid before Tynwald in January 2020.

6.4. The report should provide a climate change action plan to include ambitious target options for achieving net zero emissions with interim targets and a climate impact assessment of proposals.

6.5. The report should consider the impact on the environment, community and economy in order to propose an appropriate balance and clarify the impact of options identified.

Executive Summary

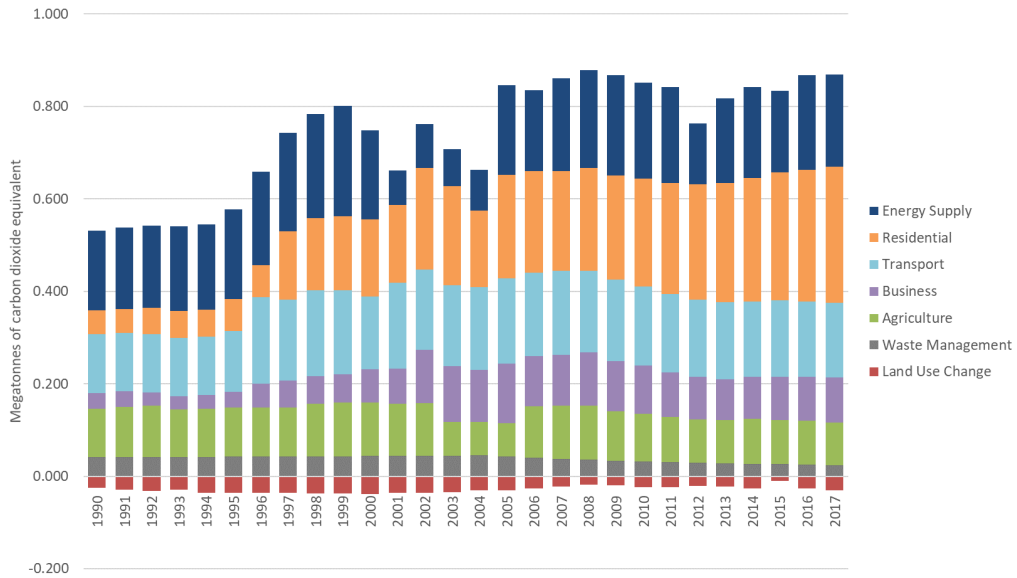
Introduction

In May 2019, Chief Minister of the Isle of Man acknowledged the global climate emergency and made a commitment to reaching net zero carbon by 2050 and bringing in a climate change bill in 2020. Following a resolution in Tynwald in June 2019, the Climate Emergency Consultative Transformation Team was formed and tasked with producing a climate change action plan that sets out a route to net zero carbon emissions. To do this, it is important to first understand current and historical greenhouse gas emissions.

Isle of Man greenhouse gas inventory

The Isle of Man greenhouse gas (GHG) inventory is compiled annually as part of the UK National Atmospheric Emissions Inventory Programme. In line with international reporting requirements set out by the United Framework Convention on Climate Change (UNFCCC) emissions are reported under 7 sectors: agriculture, business, energy supply, land use change, residential, transport and waste management. Emissions are reported for every year from 1990 to the latest year minus two e.g. the inventory published in 2019 will cover the years 1990 to 2017.

Between 1990 and 2017, emissions in the Isle of Man have increased by 66% from 0.50 to 0.84 megatonnes of carbon dioxide equivalent (Mt CO_2 eq). For comparison, total GHG emissions from the UK (including emissions from Overseas Territories and Crown Dependencies) were 798.2 Mt CO_2 eq in 1990 and 464.5 Mt CO_2 eq in 2017 (a decrease of 42%).

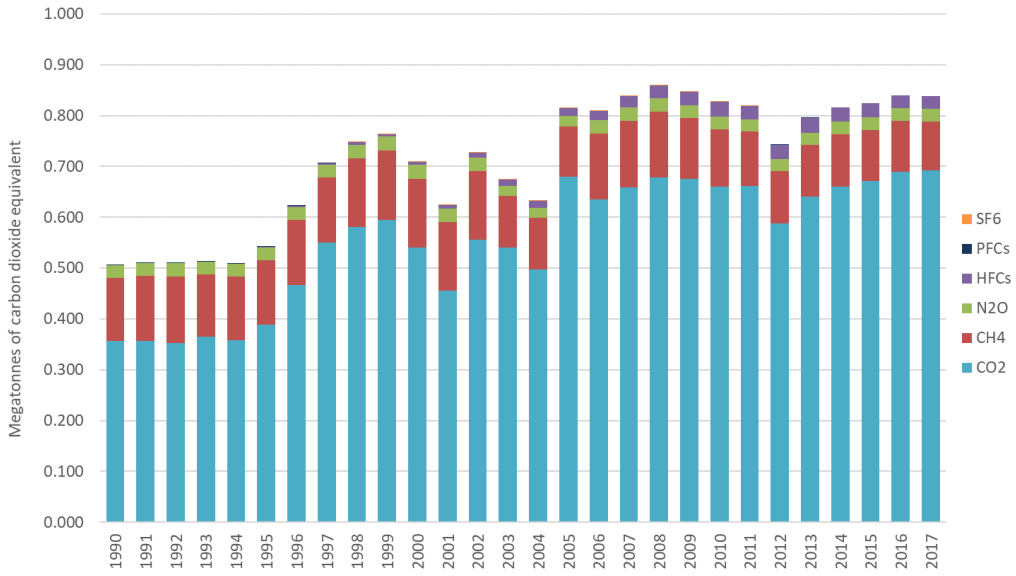


ES Figure 1 - Total Isle of Man greenhouse gas emissions by sector 1990 - 2017

In 2017, the largest sector was residential (35% of total GHG emissions). This sector also saw the largest growth in contribution to total GHG emissions across the time series. Emissions from land use change are shown as negative numbers because, overall this sector is a carbon sink.

The trend in emissions from 1990 to 2017 is largely driven by emissions of carbon dioxide (CO_2). CO_2 come almost entirely from fuel combustion activities and account for 83% of emissions in 2017. Methane (CH_4) and nitrous oxide (N_20) are important in the agriculture and waste management sectors and make up 11% and 3% of total 2017 emissions respectively. Figure 2 below shows the

total GHG emissions resolved by pollutant. The totals are lower than those shown in Figure 1 because the removal of carbon from the air (caused by Land Use Change) has been taken into account.



ES Figure 2 - Total Isle of Man greenhouse gas emissions by gas 1990 - 2017

Report overview

This report is designed to aid knowledge and understanding of the Isle of Man inventory for both policy makers and the general public. Current and historical emissions are a key basis for thinking about pathways to net carbon zero and as such it is important to know how estimates are made, what they mean and how the estimates could be improved. This provides further information on these topics including:

- **An overview of inventories**: what they are, what they include and how they are reported
- **Sector specific information on the Isle of Man greenhouse gas inventory**:
  - Trends
  - Methodologies
  - Potential future improvements
- **Recommendations**: recommended priority actions for improving the inventory and for broader climate change action planning

Ensure full consideration of other greenhouse gas emissions (CO_2e)

1. EXECUTIVE SUMMARY

1.1. This workstream is intended to review the Isle of Man inventory of non CO_2 greenhouse gas (GHG) emissions (CO_2e) and to identify any potential sources of CO_2e GHG that are not included in that inventory.

1.2. The IoM impacts on climate change through emissions of GHGs other than CO_2. These gases are: methane (CH4) released from landfills, natural gas, agriculture, especially from the digestive systems of grazing animals; nitrous oxide (N_2O) released though agriculture and livestock, fertilizer, manure, and the burning of fuel in cars; Fluorinated gases such as hydrofluorocarbons (HFCs), perfluorocarbons, chlorofluorocarbons, sulphur hexafluoride (SF6), and nitrogen trifluoride (NF3) used in refrigerants, solvents, and in shoe manufacturing. Each CO_2e is a more potent GHG than CO_2 (CH4 x 84; N_2O x 264; SF6 x 23,000) although they make up a much smaller percentage of total global GHG emissions.

1.3. Aether, the consultants used to submit the IOM GHG data to the UK annually, are producing a report identifying the data sources used for the inventory. Once this is produced it will be reviewed.

1.4. The IOM is reviewing its data on non CO_2 GHG emissions to identify areas where it can affect a reduction. This process also means seeking to identify potential future sources of CO_2e GHG so these can be taken into account. For example, a move to renewable energy production through development of windfarms is likely to increase the amount of SF6 emitted by the IoM. SF6, a synthetic gas which does not degrade naturally, is used widely by the electrical industry (large power stations, wind turbines, electrical sub-stations in towns and cities) to prevent short circuits and accidents.

Definition of a Just Transition and Climate Justice

1. EXECUTIVE SUMMARY

1.1. The suggested definition of a just transition for the Isle of Man is "A just transition ensures that no-one is unfairly disadvantaged by rapid decarbonisation"

1.2. As we make the transition towards a net zero carbon economy and society there is a risk that the most vulnerable members of society could get left behind.

1.3. The social costs of poverty and social exclusion are high, requiring a holistic, proactive and preventative approach.

1.4. Suggested actions to mitigate this risk include consideration of a just transition in decision making processes, strategies and implementation plans.

1.5. Areas for focus could include energy efficiency and insulation for those at risk of fuel poverty and re-skilling for those moving into sustainable, low carbon jobs.

1.6. Engagement and consultation, ideally including community outreach, will be important as action plans are developed and implemented.

Develop and agree policies to promote healthier diets and physical activity

1. EXECUTIVE SUMMARY

1.1. This report explores how our carbon net zero aspirations can benefit healthier diets and physical activity and vice versa. It clarifies areas of already committed strategies and policy to encourage improved health and diet as well as making recommendations to begin to monitor and measure our health and diets against our net zero commitments.

1.2. Dr Maria Neira, World Health Organization (WHO) Director of Public Health, Environmental and Social Determinants of Health stated that "The true cost of climate change is felt in our hospitals and in our lungs. The health burden of polluting energy sources is now so high, that moving to cleaner and more sustainable choices for energy supply, transport and food systems effectively pays for itself, when health is taken into account, and climate change mitigation is an opportunity, not a cost."

1.3. As the public become more engaged with our commitments towards becoming carbon neutral then this creates a real opportunity to improve statistics on mortality and general health and wellbeing. Making climate aspirations personal to the individual through food and physical health awareness and the benefits to carbon reductions on an individual level through health and wellbeing, and the small behavioural changes an individual can take to make a difference, will help to gain public buy-in for what can be perceived as a very complex and technical topic.

1.4. Research has found that "language that was technical or associated with global or government level action was seen to be uninspiring, as it removes responsibility and control from the individual". They found that their most effective messaging to promote low carbon behaviours were those grounded in every day experiences such as living a healthy lifestyle. Their research also found that drawing on ideas of collective action, shared goals and common gains made people feel their contribution was useful and worthwhile.

1.5. If this thinking is applied on Island then effective communication and engagement on reducing our carbon footprint on an individual level through healthier diets and lifestyles, open discussions around food waste and engaging in active travel can help to embed changes.

1.6. Relevant policy and strategy included discussed in this report:

- Active Travel
- Strategy for Sport 2014-2024

- Childhood Healthy Weight Strategy Draft 2019
- Health and Social Care in the Isle of Man - the next five years – 2015

1.7. Additional schemes to promote health and wellbeing discussed in the report:

- Adopting the UK's Eatwell Guide
- Creating community gardens and green gyms
- Different approaches to encourage physical activity through Education
- Creating an Isle of Man School Food Plan which can be adopted by all schools, taking into account the differing food preparation facilities within individual schools and that also commits to supplying and using local produce
- A programme of engagement and awareness – "Healthier Living for Ourselves and the Environment"
- Working with the third sector to identify suitable areas to facilitate play streets and encouraging more outdoor play
- Social prescribing – creating an environment where outdoor activity is encouraged for wellness as an alternative, where it is possible to do so, to medication
- Climate champions at student and teacher level within all secondary schools
- Benefits of eating local produce and living healthier lives taught through lessons in secondary schools
- Agreeing a set of measures to begin to monitor health improvements against net zero ambition (through social attitudes survey and public health data etc)

1.8. It should be noted here that mental health will be covered in a secondary piece of work and as such has not been covered within this report (however, there are many actions here that will have positive impact on mental health as well as physical health).

Guidance provided to the Analytical Team on process, tools, resources, guiding principles, ways of working. Drafting of the Isle of Man Government Climate Change Action Plan

1. EXECUTIVE SUMMARY

1.1. The Climate Change Analytical team, a group of officers from different Departments across the Isle of Man Government, was tasked with undertaking research and providing analysis and actions based on main emission sectors. Analytical Team members were provided with initial training on climate change science, and co-located to work collaboratively together for between 3 to 6 months.

1.2. Members of the Team were provided with guidance regarding principles, ways of working and the drafting of an action plan. They were required to identify two pathways to reduce carbon emissions within their research area to meet net zero by 2050. The first pathway was to identify the minimum necessary to achieve the end point, with a second, higher ambition pathway, to reduce emissions more rapidly in earlier years. This guidance and format was established by Professor Curran as a way informing team composition and ways of working.

1.3. The reports produced by the Analytical Team informed Professor Curran's report.

1.4. It should be noted that the guidance changed throughout as the project progressed and may not relate in its entirety to the final product, for example taking into account timeframes and information availability. However the overall philosophy remained the same.

Isle of Man Government Climate Change Analytical Team and Secretariat and Stakeholder Engagement

1. CLIMATE CHANGE SPONSOR GROUP

Role	Name
Independent Chair	James Curran
Treasury Minister	Alfred Cannan
DEFA Minister	Geoffrey Boot
DOI Minister	Ray Harmer
Treasury Chief Financial Officer	Caldric Randall
DEFA	Karen McHarg
CO Head of Communications	Liz Aelberry
DfE Chief Executive	Mark Lewin
DOI Chief Executive	Nick Black
DEFA Chief Executive	Richard Lole
Chief Secretary	Will Greenhow

2. CLIMATE EMERGENCY CONSULTATIVE TRANSFORMATION TEAM

Role	Name
Independent Chair	James Curran
MLC	Jane Poole-Wilson
MHK	Ralph Peake
DEFA Chief Executive	Richard Lole
CO Head of Communications	Liz Aelberry

Individuals from the following Departments and Roles formed the Analytical and Secretariat Team
Department of Environment, Food and Agricultural
Department of Infrastructure
Department Education and Social Culture
Department of Home Affairs
Cabinet Office
Department of Enterprise
Manx Utilities
Treasury

Additional technical support

2.1. Technical support was provided to the Analytical team by Eunomia, a consultancy company with specialist staff in climate change.

2.2. Support was provided by officers across the Isle of Man Government and other local specialists.

3. STAKEHOLDER AND COMMUNITY ENGAGEMENT TO INFORM THE CLIMATE ACTION PLAN WORK

Short Overview

3.1. Engaging and consulting key stakeholders and the wider community is an essential part of the process for creating the Isle of Man Climate Change Action Plan. Although the timescale for this work has been very short, every effort has been made to seek views from stakeholders and the public to inform the work. The results from the Climate Change Mitigation Strategy 2020-2030 consultation, held prior to the formation of the climate change team, was also utilised in the formation of the action plan.

August Stakeholder and Community Climate Change Workshops

3.2. These two events invited Isle of Man residents and Stakeholders to Climate Change Workshops in order to:

- Introduce the community to Professor James Curran, the independent Chair of the Climate Emergency Consultative Transformation Team
- Provide the community with an overview of the project plan
- Explore how emission reductions can be achieved and where there is opportunity for increased carbon storage in nature
- Obtain ideas on how to reach net zero emissions in each of the sectors and explore associated opportunities for a better future
- Gather feedback from the community about their main concerns and any foreseeable difficulties in the goal of reaching net zero emissions
- Discuss how innovation and community involvement can support this process

3.3. An additional event was held for the UNESCO Biosphere Isle of Man Stakeholder Partnership group which offered the same opportunities.

3.4. All feedback was written up and available to the climate change team to help inform the creation of the individual reports.

September Stakeholder and Community Climate Change Workshops

3.5. Building on the August workshops, these events once again invited the Isle of Man residents and Stakeholders to Climate Change Workshops in order to:

- Provide an update about progress with developing the action plan

- Meet members of the Climate Emergency Consultative Transformation Team and discuss relevant sectors/issues in more detail.
- Hear Archibald Elliott from the Isle of Man Student Climate Network give a youth perspective.
- Ask for feedback and input on actions we can take to reduce emissions
- Provide information on climate change and our island, and the previous community workshop

3.6. The stakeholder and community events were attended by members of the climate change analytical team, who spoke to individuals at 8 "workstations" to get targeted feedback and ideas in the main carbon emitting sectors. All written feedback was taken away by team members for consideration.

Stakeholder Meetings

3.7. James Curran endeavoured to meet as many key stakeholders as possible during his visits to the Isle of Man. During these meetings Prof Curran met representatives of the following organisations:

Organisation
Various individuals from Central and Local Government
Blue Sky Labs
Crogga
Ecoblog IoM
Isle of Man Youth Climate Network
Manx Gas
Manx National Farmers Union
Manx National Heritage
Peel L&P Energy
The Chambers of Commerce and Manx Technology Group
The Climate Change Coalition
The Department for Enterprise Executive Agencies
The Law Trust

3.8. Additionally, at the Stakeholder, Community and Biosphere events James Curran met with and talked to a variety of different individuals and organisations from across the Isle of Man.

3.9. A meeting with His Excellency the Lieutenant Governor, Sir Richard Gozney.

Climate Change Government Inbox

3.10. A climate change contact email was made available, to ensure that the public can directly contact the Climate Change team for any enquires. The email address has been shared at the Stakeholder and Community workshops and located on the Isle of Man Government Climate Change web page - climatechange@gov.im.

3.11. James Curran also shared his Government email address at the Community and Stakeholder events.

3.12. Due to the timescales, it was not possible to reply to everyone who sent in emails, however, where possible and appropriate, attempts were made to put individuals in contact with relevant members of the climate change team.

Communications Officer

3.13. In September, Cabinet Office appointed a climate change communications officer who has worked with Prof Curran and the Analytical Team on developing a climate communications plan.

Isle of Man Government Dialogue

3.14. Isle of Man Government opened an online portal inviting residents to ensure that the action plan that will go to Tynwald reflects the views of the Island's community.

3.15. The online consultation tool opened on the 19th September and closed on 18th October; it received 211 responses.

3.16. The work of the Analytical team was split into nine discreet subjects for the residents to share their ideas and feedback by using the comments facility under the discreet subjects (number of responses under each given in brackets);

- Agriculture
- Business
- Education and Health
- Energy Supply
- Land-use
- Waste
- Residential
- Transport
- Other

Stakeholder Meetings by members of the Analytical Team/other input from stakeholders

3.17. The Analytical Team have consulted with Stakeholders in relation to their individual work packages.

Individuals from Central and Local Government;
Cabinet Office
DEFA
DESC
DfE
DHA

DHSC
DoI
Local Authority Reps.
Manx National Heritage
MUA
Treasury;

Local groups, Third Sector, Private Sector	
Aether	Manx Lottery Trust
Athol Garage	Manx National Farmers Union
Clean Tech Forum	Manx Solar Electric
Climate Change Coalition	Manx Wildlife Trust
Culture Vannin	Mountain View Innovation Centre
DfE executive agencies	Noa Bakehouse
Ellan Vannin Fuels	Ocean Ford Car Dealership
EV Mann	One World Centre
Grazing and Shooting Tenants	Ørsted
IoM Fund Managers	PDMS
Isle of Man Flockmasters Association	Peel L&P
Isle of Man Steampacket	Rep from UK onshore renewable developer
Jacksons Car Dealership	Suez Isle of Man
Juan Brown (Oceanographer)	Swift Motors
Local Financial Institutions	The Hub community Group
Manx Gas	

3.18. Additionally, a number of individual consultants were engaged specifically for their detailed input into a number of workstreams.

Media Interviews

3.19. As well as attendance at public engagement events, James Curran also undertook interviews with a number of local media sites, to inform and educate the wider Isle of Man population;

- MTTV
- 3FM
- IOM Newspapers
- Manx Radio
- BBC IOM

Establish easy mechanisms for donations, offsetting fund and IOM scheme(s)

1. EXECUTIVE SUMMARY

1.1. Carbon offsetting provides a mechanism to pay to balance greenhouse gas emissions with the equivalent carbon sequestration, resulting in a net zero outcome.

1.2. A carbon offset scheme could be administered by an on-Island Charitable Trust with independently Trustees and operated on an arms-length basis with estimated administration costs <10% p.a. There would be an expectation that offset projects would be operated by Isle of Man (IOM) Government Departments in order to maintain traceability, monitoring and control of carbon sequestration and/or emissions reductions.

1.3. A fundamental obstacle to any IOM offset scheme is project accreditation (informing the credibility of schemes and inclusion in reportable emissions). The projects and offset units will require verification by independent auditors through internationally recognised standards. These standards ensure the projects are implemented, run and managed properly and the credits they generate represent real and actual emissions sequestered or avoided. To date the international standards (Clean Development Mechanism (CDM) contained in the Kyoto Protocol) restrict what projects can be conducted in the UK i.e. under CDM developed countries could invest in offset projects only in developing nations. The Paris Agreement however means domestic mitigation measures can be pursued with the Paris Mitigation Crediting Mechanism replacing CDMs. To date however there is no precedent.

1.4. There is therefore a potential opportunity for IOM to establish an offset scheme with on-Island projects as test beds and, if certified appropriately, use these to claim emissions reductions e.g. design scheme/projects to limit to ownership of reduction to IOM residents and businesses purchasing IOM offset units/certs. Detailed forecasts of project finance requirements, potential CO_2 reduction, availability and demand for offsets would be required; especially given the inherent intermittency of funds flow from voluntary offsetting.

1.5. Emissions reduction should always take precedence over carbon offset. However, offset is recognised by the Inter-Governmental Panel on Climate Change as a necessary interim measure to achieve net zero emissions targets. IOMG may determine to establish a voluntary carbon neutral standard and certification for businesses to provide guidance, support and demonstrate Island carbon neutrality.

1.6. Whilst there is currently no requirement for carbon disclosure, there may be appetite for Island businesses to participate as a means of enhancing brand reputation and to provide competitive advantage against a backdrop of public pressure for climate action and sustainability.

1.7. Currently businesses can give carbon neutral claims credibility with the internationally applicable *British Standards Institute PAS 2060 Specification for the Demonstration of Carbon Neutrality* (British Standards Institute, 2019) however, as referenced above, IOM could have its own standard and certification based on BSI specifications (e.g. British Standards Institute. (2011). *PAS 2050:2011 – Specification for the assessment of the life cycle greenhouse gas emissions of goods and services.)*.

1.8. Further work is required to estimate total carbon store and the viability of this scheme.

1.9. It will be necessary to identify what projects are capable of delivery on IOMG estate(s) and those that would require third party input/reliance/contract to deliver and to establish a mechanism and framework to evaluate the merits of each project on a consistent basis.

1.10. It will also be necessary to identify what projects are already in course (or potentially planned) and associated costs expected to be met from IOMG Revenues, and would therefore not be available for offset due to additionally. Only projects that wouldn't otherwise be possible would be eligible (e.g. from IOM Carbon Offset).

1.11. The advantage of using a Charitable Trust to administer an IOM offset scheme is the opportunity for offset purchasers to potentially claim up to £7K p.a. tax relief if the acquisition/donation meets the public benefit test. IOMG retaining control over project operations however mitigates risk of project failure due to availability and timing of funding.

1.12. The success, or otherwise, of an IOM voluntary offset scheme will be wholly reliant on its credibility as people will only donate to causes they consider are legitimate and worthwhile. There is a danger that offsetting may be perceived as a means of absolving Government from taking action that may otherwise have been funded; therefore transparency in the documentation and auditability of additionally will be key in addition to an arms-length SPV administrator with sound financial governance being appointed to receive and distribute funds.

Embed zero carbon concepts into the Isle of Man Government and the wider community

1. EXECUTIVE SUMMARY

1.1. Embedding zero carbon concepts is a challenging and crucial part of reducing our carbon footprint, contributing towards net zero carbon emissions by 2050.

1.2. There is a need to consider how the concepts of carbon neutrality, ecosystem services and biodiversity might be placed at the heart of everything we do.

1.3. A simple and clear approach is needed to enable joined up working, realising potential and utilising all available assets.

1.4. System-wide alignment could help us to identify and articulate priorities and beliefs, finding common ground to engage, unite and inspire individuals, groups and organisations.

1.5. Three core principles are explored to enable this process to begin:

- Our intentions and beliefs are visionary and strategic;
- Our plans and actions are viable and sustainable and encourage self-reliance;
- Our processes and delivery mechanisms ensure that all voices are heard and valued.

1.6. Processes to embed zero carbon concepts could be supported through an impact assessment which underpins all decision making and procurement in all publically funded bodies.

1.7. Additionally, revising the Programme for Government to encompass zero carbon concepts could raise their profile, enabling strategic and operational alignment to shared priorities and a common vision.

1.8. Importantly, aligning funding to support zero carbon concepts and priorities is necessary to support effective implementation and delivery.

Explore incorporation of climate science into the Manx national curriculum

1. EXECUTIVE SUMMARY

1.1. The statutory curriculum for Isle of Man schools is laid out in the Curriculum Order 2011 and underpinned by the Department of Education, Sport and Culture (DESC) Essentials for Learning (E4L) curriculum, which provides a broad framework for essential academic, social and personal skills.

1.2. Curriculum content in the 37 Isle of Man schools (32 Primary, 5 Secondary) operated by the DESC is largely drawn from the English national curriculum. Curriculum content also draws on the Island's unique geographical, cultural and historic features.

1.3. Consistency varies regarding the delivery of climate science across the schools; however any teaching of climate change remains quality assured by the Education Improvement Service.

1.4. In the Island's primary schools, climate change is taught though a variety of topics based upon their individually determined curricula and it is likely that content and consistency varies across the schools.

1.5. In secondary schools climate science is covered within the Cambridge Assessment iGCSE Sciences Co-ordinated (Double) curriculum. Alternatively students may sit three separate science iGCSEs else BTech Science. The iGCSE Single and Combined Science Statements refer briefly to climate change and atmospheric carbon within Biology and Chemistry. Climate change is also covered in the GCSE geography syllabus, however this is not a compulsory subject.

1.6. The Island's only private school, King Williams College (KWC), curriculum adopts the International Baccalaureate Diploma - studied by all Sixth Form students – and where climate science is explored and embedded within both the Geography and Environmental Systems and Societies syllabi. In the Fourth Form and Lower Fifth (Years 7 to 9) KWC broadly follows the requirements of the National Curriculum.

1.7. United Nations Institute for Training and Research: as part of its 2011-2013 implementation phase "The One UN Climate Change Learning Partnership" (UNCC:Learn) developed a Resource Guide for Advanced Learning on Integrating Climate Change in Education at Primary and Secondary Level.

1.8. Effective outreach is required for students to understand climate science in easy to understand language and in a hands-on/visual environment. Isle of Man

students are fortunate to have regular access and opportunity to engage with local environmental groups e.g. Manx Wildlife Trust, One World Centre, Beach Buddies etc. Bringing the science to life within the fabric of the school/learning environment is also useful e.g. Queen Elizabeth 2nd (QEII) high school biomass boilers, solar panels, making sustainable clothing etc.

1.9. Climate change is a pervasive phenomenon that requires a multidisciplinary approach i.e. permeation across all areas of the curriculum so that it becomes natural and less daunting. For example, not just restricted to science or geography lessons but in home economics (change in food production, supply and diet), PSE (personal and social impact and concerns), language (mass migration), art (changing landscape) etc.

1.10. E4L provides flexibility to weave climate science through all elements of teaching however iGCSE appears to confine material to biology and chemistry.

1.11. Going forward, DESC plans to produce, in collaboration with DEFA, Manx Climate Science guidance pdf documents for all schools that are aligned to the UN Sustainable Development Goals (SDGs). DESC will also approach all Isle of Man primary and secondary Head teachers by the end of Jan 2020, to further discuss how climate science can be covered consistently.

Launch Urgent and comprehensive peatland condition surveys and remediation programmes

1. EXECUTIVE SUMMARY

1.1. The Island's largest peat reserves, and therefore the Island's largest carbon store, are located in the uplands. Largely uncultivated, the Manx hills are dominated by semi-natural habitats. Significant, yet unquantified peat reserves are also found in areas like Ballaugh Curragh and the Central Valley.

1.2. As the majority of the upland peat reserve is found on the Government land estate, it provides us with a unique opportunity to shape future land management through appropriate restoration guided by Landscape-scale management plans.

1.3. A comprehensive survey of the depth and extent of the Island's upland peat (the Manx Mires Partnership – MMP) is currently being undertaken by Manx Wildlife Trust, in partnership with The Department of Environment, Food and Agriculture (DEFA) and Manx National Heritage (MNH). This survey will focus on mapping the Island's peat extent and provide a finalised evidence base. This survey has focussed on the Sulby catchment to date, but it will extend to cover the remaining upland areas. It is estimated that there may be up to 20 Mt CO_2 equivalent stored in the upland peat, although this estimate will be revised upon completion of the survey. However, using this estimated figure, the value of the carbon currently stored in the uplands is £158.2 million (based on £27/tonne of CO_2 equivalent).

1.4. Research carried out in 2017 on behalf of DEFA focused on four differing upland sites and estimated that the Manx upland peat soils could be sequestering as much as 18,000 tonnes of CO_2 annually. One of the studied sites contained historic peat workings with their associated erosion and exposed peat and all of the sites included historic drainage. Despite this, the combined results still favoured the uplands to be a sink of carbon rather than a source. Functioning peatlands continue to sequester CO_2 over very long periods, hence the significant storage figure above. However, degraded peatlands can be a significant source of greenhouse gases.

1.5. Peatland sequestration at 18,000 tonnes of CO_2 a year would offset 2.25 % of anthropogenic CO_2 emissions at current rates and carbon storage on the uplands has the potential to store over 9 % of the total anthropogenic emissions.

1.6. Restoring habitats to functioning blanket bog and fen, where appropriate, will increase the annual sequestration figure and have a positive impact on biodiversity. To inform extensive restoration, further research is required to establish peat depth and condition. To survey the remaining upland peat (South of Central Valley) and lowland peat sites for peat depth and extent may cost in the region of £22,500. However, to inform future restoration plans, more detailed

survey work is required to assess habitat and peat condition. These additional survey costs are broken down in more detail within the document.

1.7. In simplistic terms, peatland restoration means intervening where previous land management actions have changed site hydrology and vegetation or have led to erosion. This could mean 'rewetting' habitats by partially blocking man-made drains, re-profiling old peat workings and other areas of erosion. Appropriate use of the Governments Light Detecting and Ranging (LIDAR) dataset in conjunction with Geographic Information System (GIS) mapping will help to locate partially hidden drainage systems and model natural drainage, thus informing potential restoration works.

1.8. As previous local peatland habitat restoration and enhancement works have been carried out in an experimental and ad-hoc manner, it is not possible to give accurate costings based on local experience. However, it has been estimated that the average cost of restoring peatland is £830/ha with ongoing expenses of between £25 and £400/ha/year, although the actual cost will depend on an assessment of the restoration needs. These estimated costs should be viewed in the context of the estimated value of carbon stored in the uplands as £158.2 million and an estimated annual ecosystem services value for wetland and mire of £9598/ha/year.

1.9. Of the estimated upland peat area of 10,273ha, only 639ha has been classified as wetland and mire. This area may change with future surveys and if restoration work succeeds in re-wetting habitats. An expansion of bog habitats could potentially increase the overall value of the ecosystem services provided as well as preserve and increase the value of the carbon stored.

1.10. Peatland restoration combined with additional habitat connectivity in terms of well-planned woodland establishment will not only sequester and store CO_2 but will also have a positive effect on biodiversity, flood alleviation and water supply. Positive upland management, especially in terms of re-wetting peatlands through intervention and restoration will provide essential natural flood risk management (NFRM) objectives at the source. This document has not fully explored the value of such works in terms of direct NFRM, but further research is recommended to facilitate multiple potential benefits from such intervention.

1.11. As well as carbon stored in peat, active bogs can hold a valuable store of carbon in their above-ground biomass. It has been estimated that a 15cm sphagnum layer can have a carbon content of up to 50 tonnes of carbon per hectare and this is comparable to the total above and below-ground biomass of some 50-year-old conifer plantations.

1.12. Upland heathlands are dominated by native dwarf shrub species which flourish on the shallower and drier upland peat soils. Heaths are habitats of global importance and are protected locally by the Heath Burning Act 2003. The Act allows for

appropriate vegetation management, including rotational burning. Heather management can provide multiple benefits when carried out correctly, and it can significantly reduce the risks associated with unplanned wildfire, thus protecting carbon stored in peat. One study looked at carbon accumulation rates on peat heathland that were managed with fire. They found that while fire does slow down the accumulation rate of peat, which is more significant with a greater burning frequency, it does not stop the growth of peat. They concluded that this type of management can mitigate wildfire risk as well as providing a habitat for a variety of species.

1.13. Wildfire is considered to be the most significant risk to stored carbon in a peatland context. A deep-seated fire could consume vast amounts of peat releasing carbon that has accumulated over thousands of years in a matter of days or weeks. It is therefore essential to reduce this risk through appropriate land management, partnership working and education.

1.14. Current land management practices will likely require modification to maximise carbon sequestration and this may involve assessing upland stocking levels. However, and upon consideration of this report, it is not felt appropriate to remove all livestock from the uplands. Positive land management is required to help protect the vast stores of peatland carbon, and upland managers are best placed to deliver this service.

1.15. Upland sites will likely be considered for on-shore wind energy generation in the future. This once again highlights the importance of accurately surveying upland peat extent and depth to help inform planners and renewable energy developers.

1.16. The Isle of Man has the highest density of breeding and wintering hen harriers *Circus cyaneus* in the British Isles. Prime habitat is typically managed heathland, with a variety of age structures and low intensity sheep grazing; in these locations territories can be at a density of 1 per 800m^2.

1.17. The majority of future sequestration and off-setting projects will rely on the co-operation of the Agriculture sector. It is therefore essential to maintain clear, and positive, lines of communication to ensure that crucial joint working initiatives are embraced and not compromised.

1.18. Should the appropriate funding become available, peatland restoration can be commenced on known degraded sites on the Government upland estate following the appropriate ecological assessments and planning approval.

Instigate ambitious and widespread woodland, semi-natural habitat creation and tree planting options to maximise carbon sequestration and increase natural habitat connectivity.

1. EXECUTIVE SUMMARY

Context

1.1. Land-use on the Isle of Man provides a carbon capture and storage sink in wooded and afforested land, peatlands, wetlands and other semi-natural habitats including permanent grassland.

1.2. Land has the capacity and potential to deliver enhanced carbon sequestration, through appropriately planned tree planting, woodland creation, protection of existing trees and semi-natural habitats, habitat creation, restoration and maintenance of healthy, connected habitats and woodlands.

1.3. Land also provides important additional benefits for climate change resilience, biodiversity and ecosystem services. For example; natural flood risk management, increased air and water quality, natural pest control and community health and wellbeing.

1.4. Whilst the catalyst for this report has been the Isle of Man Government's commitment for the Island to reach net zero carbon emissions by 2050, it is essential that the pursuit of this objective must not be achieved at the detriment of local ecosystems and biodiversity.

1.5. It is acknowledged that there is a global biodiversity and climate change emergency, therefore priority should be given to measures which deliver both biodiversity and climate benefits. Biodiversity is important in its own right, but it also plays a crucial role in climate and ecosystem resilience, and provides ecosystem services.

1.6. The actions required for the protection of our carbon stores and biodiversity and for increased carbon storage and sequestration capacity, will result in a healthier landscape, much richer in trees and semi-natural habitats and more resilient to climatic events. Not only should our biodiversity benefit, but the health and wellbeing of the entire island population should be enhanced.

1.7. Though natural carbon storage and sequestration solutions have a part to play in balancing emissions and reaching net zero, this should not be seen as an alternative to industry de-carbonisation.

Opportunities

1.8. Enhanced tree cover could be achieved through the promotion of appropriate rural and urban planting on agricultural, Government and private land, in the form of properly assessed woodland creation, smaller scale tree planting (including hedges), and incorporation of more trees across a range of housing and infrastructure developments.

1.9. The adoption of agroforestry techniques could be a way of rapidly incorporating tree cover on agricultural land whilst allowing farming to continue without loss of productivity.

1.10. Adequate payments (and no loss of area payments) for the creation or enhancement of environmental features such as for tree planting, restoration of ponds and semi-natural habitats, as well as ongoing management advice under an agri-environment scheme could lead to wide-scale uptake in the agricultural landscape.

1.11. Increasing environmental impact assessment requirements to protect habitats from damaging agricultural activities would assist in the retention of existing habitats.

1.12. To maximise biodiversity gains, planting efforts should concentrate on expanding existing native woodlands and creating links and corridors. However, for rapid carbon-sequestration benefit, appropriately planned conifer forest within a broadleaf mix and managed with sustainable methods, can play an important role within a comprehensive tree-planting programme.

1.13. Flexibility with the use of some non-native tree species and the planting of an increased diversity of species will be required to ensure long-term climate resilience of Manx forests.

1.14. Habitat conservation and restoration for ecological connectivity can be achieved by designating the most important areas of semi-natural habitats as Areas of Special Scientific Interest (ASSIs) or other statutory designations and making further provision for their ongoing monitoring and maintenance, taking measures to increase the quality of hedgerows and verges, working with the agricultural sector and wider public to improve protection and management of existing habitats, promoting the restoration of degraded habitats and by creating new habitats where appropriate.

1.15. Ecological connectivity can be achieved by ensuring that new habitat creation is concentrated between areas of existing habitat, requiring assessment, planning and co-operation between landholders and managers to be successful.

1.16. Consideration should be given to either widening elements of the proposed agri-environment scheme or opening up a new scheme, e.g. a woodland creation grant scheme, for land owners who do not qualify for inclusion in the Agricultural Development Scheme (ADS).

1.17. Government should continue to lead by example in limiting destruction or damage to habitats by integrating climate change, ecosystem services and biodiversity considerations into all policy and work practises and delivery making processes, ensuring implementation of existing policy and strategy, and committing to the delivery of direct, positive climate actions and wider complementary actions.

1.18. Delivery of the existing Biodiversity Strategy should be prioritised as urgent, including the rapid development of a high level Delivery Plan.

1.19. The private sector should be encouraged to explore options relating to corporate environmental responsibility including tree planting and habitat creation.

1.20. The planning system should be updated to incorporate the concept of 'Biodiversity Net Gain', ensuring that, where actions have negative carbon and wider environmental consequences, mitigation is incorporated that is appropriate and equivalent, and as such long-term management of environmental features is guaranteed.

1.21. Increased public education and awareness as part of a communications strategy is key to developing understanding of the importance of a healthy ecosystem for the wellbeing and sustainability of the island.

1.22. Specific climate and biodiversity indicators should be adopted to ensure that the impact of climate change on our island is understood and being mitigated against.

1.23. Local carbon offsetting programmes are not currently offered, and although not a long-term solution for carbon reduction, local initiatives could provide a valuable means of funding for planting schemes in the short term.

1.24. The restoration of ecosystems will play a pivotal role in climate change adaptation and should be a key consideration in future climate change planning.

Issues

1.25. Land becomes a source of emissions when damaged or destroyed, e.g. via conversion to settlements or productive farmlands, or through poor management.

1.26. Poorly managed wetland habitats can become a significant source of emissions when the organic matter dries out and decays. This can be caused by drainage, trampling by livestock, lack of management and abandonment.

1.27. More research, planning, assessment and collaboration is required prior to wide-scale woodland and semi-natural habitat creation to determine the best areas, to avoid negative impacts and ensure long-term viability and climate change resilience, however this will need to be actioned immediately for the greatest benefit.

1.28. Carbon sequestration and storage rates in trees is variable and depends on factors such as tree species, soil type, growth rate and age, therefore carbon calculations are complex and hard to estimate and precise calculations on carbon storage and sequestration are not possible at present.

1.29. Carbon sequestration and storage levels in Isle of Man semi-natural habitats is hard to estimate as up to date information about habitat types, extent and condition is incomplete and sequestration rates vary significantly.

1.30. Barriers to implementation include availability of resources and funding, willingness to adopt, lack of and out-of date information, maintenance and diseases.

Costs

1.31. Tree establishment costs are estimated at £3 - £7 per tree, depending on management costs. Based on a planting density of 1,400/ha, estimated costs vary between £4,200 - £9,800/ha. If land purchase is required for planting then costs could be around £10,000 higher per hectare.

1.32. The Isle of Man currently has around 9.3% woodland cover. A short-term woodland target to increase cover to 10% would cost between £1.4M- £3.4M over a 5 year period (between £288,891 - £674,079/yr).

1.33. Longer-term targets to increase woodland cover to 15% would cost between £13.4M - £31.4M. The more ambitious target of 15% by 2035 would cost between £898,000- £2,100,00/yr. The less ambitious target of 15% by 2050 would require costs of £500,000 - £1,100,000/yr (not including land price).

1.34. Carbon sequestration and storage rates vary greatly between habitats and habitat condition. Further research is required to estimate the storage and sequestration potential of Manx habitats and to obtain more accurate habitat creation and restoration costs.

Explore the potential for developing blue carbon (marine and coastal sinks of carbon) to achieve net zero

1. EXECUTIVE SUMMARY

1.1. Blue carbon refers to the potential of ecosystems in the marine and coastal environment to remove (sequester) carbon from the atmosphere and store it within habitats, sediments and species, creating a store of carbon.

1.2. Types of blue carbon ecosystems include seagrass, kelp forest, tidal saltmarsh and marine sediment. It has been estimated that these ecosystems can sequester and store 2-5 times more carbon than terrestrial habitats such as woodlands.

1.3. Similarly, the chemistry of the sediments from these ecosystems suggests the absolute comparative value of the carbon sequestered per unit area may be greater than similar processes on land, due to their lower potential for emission of greenhouse gases (GHGs) such as methane and carbon dioxide (Laffoley and Grimsditch 2009).

1.4. Blue carbon provides an opportunity to locally offset difficult to eliminate emissions that will have to continue to some extent until 2050 and beyond.

1.5. Blue carbon ecosystems are also of high importance because of the significant goods and services they provide, as well as carbon storage potential.

1.6. A recent Isle of Man postgraduate project estimated the total current carbon sequestration capacity of our territorial seas (0 – 12 M) to be around 0.2mt/C yr-1. To put that into context, Aether estimate that in 2017 the Island's net emissions were 0.84mt/C yr-1).

1.7. Blue carbon research is relatively new and, as such, policy and international emission auditing programs have not yet factored all blue carbon ecosystems into international emission auditing frameworks; at present just seagrass, saltmarsh and mangroves.

1.8. However, research in the field is moving rapidly and it has been suggested that more attention should (and will) be paid to blue carbon ecosystems for climate mitigation and adaptation strategies in the future.

1.9. As an island with over 85% of its territory in the marine environment, it makes strategic sense to manage and maximise the benefits of the Isle of Man's seas in terms of climate mitigation and adaptation. Similarly managing the Isle of Man's territorial seas for its blue carbon could have significant potential in showcasing the Island as an innovator and at the forefront in this rapidly developing field.

1.10. As research in the field develops, it is advocated that the precautionary principle should apply when managing the Isle of Man's territorial seas in relation to activities that could adversely impact blue carbon ecosystems, whilst developing and promoting policies relating to the conservation, protection and restoration of blue carbon habitats.

1.11. The potential for future carbon offsetting schemes to include blue carbon ecosystems should also be explored.

Launch a stretching energy efficiency programme for the government estate

1. EXECUTIVE SUMMARY

1.1. The Isle of Man Government Estate consists of around 800 properties, along with 1,200 properties in the Social Housing stock of the Department of Infrastructure (DOI). The Estate has an estimated value of £1.1 billion and an estimated energy usage of £15 million per annum.

1.2. The Estate is managed through collaborative working between Estates Shared Services and Departmental Estates Managers.

1.3. To enable the Government Estate to become net zero carbon it is necessary to think beyond the carbon footprint of Government buildings.

1.4. Consideration of the following points is required:

- Co-operation, collaboration and co-location;
- Utilising technology;
- Delivering Government services in a different way;
- Ensuring Government buildings are as effective as possible.

1.5. To deliver a net zero carbon Government Estate by 2050 (or earlier) will be a challenge and will fundamentally change the way Government works.

1.6. It is important that Government:

- Ensures energy usage across the Government Estate is captured centrally. Software solutions and smart metering solutions are needed to assist in this. It will be important to set stretching Key Performance Indicators (KPIs) on the building stock and monitor/review progress and performance. This data set can also feed into future strategic decisions;
- Gather data to enable the carbon footprint to be established for each asset. This will give a true reflection of the impact of each building, beyond just the energy use and will allow further targets to be set and an overall carbon footprint to be calculated;
- Create an Energy Fund (suggested value £5 million per annum) to allow application by business for energy saving and carbon reduction initiatives. Estates Shared Services should be the central coordinator for approval/rejection and onward submission to Treasury. The approval process should be focused on emissions reduction;
- All new capital builds to be net zero carbon—this will require adoption of a standard such as Building Research Establishment Environmental Assessment Method (BREEAM), or an equivalent, for all future capital schemes;

- A Strategic Review of the entire Government Estate is needed and although this review will be a challenging piece of work, it is essential. It should encompass how Government delivers its services, makes travel arrangements, provides for service users etc. as well as building stock.

1.7. This Strategic Review will deliver a plan, with timescales, to enable the entire Estate to begin moving towards net zero carbon. It will inform how Government works and delivers its services more effectively going forward.

1.8. There will also be benefits to the Isle of Man Government beyond achieving net zero carbon, such as:

- Long term future planning of capital schemes;
- Reduced risk related to a lack of contractor resources for the delivery of renewables;
- Sets all Departments and Staff a clear goal and direction to work towards;
- Creates a first class service for future generations.

1.9. To enable the Isle of Man to achieve net zero carbon by 2050, Government must lead by example in the way it deals with its estate assets.

Public/private advisory service to promote water/heating/lighting efficiency

1. EXECUTIVE SUMMARY

1.1. The single biggest sector, by emissions figures is energy use of buildings. In 2017 approximately 296,000 tonnes (35%) of the Island's CO_2e emissions came from heating appliances that burn fossil fuels such as oil and gas (Aether, 2019).

1.2. It would be possible to re-launch previous successful energy efficiency schemes such as the "Energy Doctor" via a Non-Government Organisation at modest costs (£120k in 2008-2011).

1.3. It would be beneficial to launch an energy advice / support scheme to follow the introduction of the Standard Assessment Procedure (SAP) - energy ratings for buildings launch in January 2020, and to coincide with the revision of existing Building Regulations.

1.4. Introducing internet-based Energy Advice Service, akin to UK Energy Savings Trust "Home Energy Check" would provide an objective, neutral advisory service.

1.5. There is a need to increase incentives (grants, 0% loans, low interest loans) for home owners to improve take up of energy efficiency works, as uptake of current scheme is consistently low.

1.6. To support effective implementation of energy efficiency measures, a training programme to upskill the existing construction sector workforce will be required. A properly skilled workforce is critical to enabling effective deployment of energy efficiency and low-carbon heating measures which perform as they should.

1.7. Fuel Poverty remains an issue: the 2018 Private Sector House Condition Survey. Based on the definition of spending >10% of their annual household income on energy, on this measurement, 4,000 private sector households (11.6%) are affected. Energy efficiency programmes should be targeted at those properties and households most in need.

Assess options for maximising the net renewable energy production from the Energy from Waste facility

1. EXECUTIVE SUMMARY

1.1. This work stream considers the contribution made by the Island's Energy from Waste Facility (EfW) in providing renewable electricity on Island for the Island. It reviews the options for increasing net energy production, and for reducing the net carbon footprint of the EfW. In 2018 the EfW total footprint CO_2 emission was 7,500 tonnes per annum, taking into account other fuel uses, removal of CO_2 from biogenic sources (considered short cycle carbon) and carbon savings from electricity generation. The total Process Carbon Emissions was 50,000 tonnes per annum of CO_2. This is stack emissions through the processing of the waste, and takes into account the calorific value of the waste and fuel used by the burners.

1.2. The EfW is primarily a facility for disposing of the Islands combustible wastes. It has two incinerators. The primary waste incinerator (PWI) has capacity to process up to 60,000 tonnes of mixed household and commercial waste a year. The secondary waste incinerator (SWI) is a high temperature facility for the disposal of clinical wastes.

1.3. On average the Isle of Man delivers 50,000 tonnes pa of waste to the EfW, subsequently exporting circa 25,000 MWh electricity (2017) to the National Grid. A percentage of the electricity is able to be counted as renewable as it is produced through the combustion of biogenic waste. However the EfW has the capacity to produce more electricity if it burns more combustible waste. This increase in electricity could also be achieved by removing the non-combustible fraction of the waste stream (metals). In addition, were the waste feedstock to increase, this would prevent an unscheduled non-maintenance EfW shutdown which is caused due to the lower waste tonnages, and requires the use of virgin oil. Oil use could also be reduced through a change in SWI technology.

1.4. There are two possible sources of additional combustible waste feedstock: waste material not delivered to the EfW but disposed of by unregulated means, and biomass. The Isle of Man does not have legislation prohibiting unregulated burning of wastes in the open air, the only exceptions being on licenced waste disposal sites or where the burning is determined to be a statutory nuisance. The open burning of waste is known to occur across the Island, albeit there is no data on exact tonnages or waste types. Were legislation to be introduced to prohibit or restrict open burning of waste (akin to the UK Clean Air Act 1993) this would divert combustible wastes via the EfW increasing the tonnage.

1.5. The Department of Environment Food and Agriculture (DEFA) produces biomass which could be used throughout the year to supplement the EfW waste feedstock.

The cost of biomass procurement and transportation would need to take account of the impact of this on reducing Island wide carbon emissions.

1.6. As a means for reducing territorial carbon emissions the report will also consider options for closing the EfW, redirecting the organic fraction of the waste stream via an anaerobic digestion facility, and exporting the remain wastes as refuse derived fuel to the UK for disposal.

1.7. The report does not consider the embedded carbon in materials and goods imported and goods and wastes exported.

Determine the most beneficial use for heat from the Energy from Waste Facility

1. EXECUTIVE SUMMARY

1.1. This report considers the CO_2 /Greenhouse gas (GHG) reduction potential of retrofitting heat recovery technology and infrastructure at the Energy from Waste Facility (IoM EfW), heat which could then be used to off-set reliance on fossil fuel heating.

1.2. The IoM EfW produces electricity, but does not recover the heat generated as part of the combustion system as a combined heat and power plant (CHP). Although the heat is used in part within the Plant, it is not exported in the form of district heating. The Plant could be modified to allow for the recovery of heat, which could be exported and used to heat buildings, thereby reducing reliance upon fossil fuel based energy.

1.3. In 2010 a report by AEA Technology estimated the costs of retrofitting the EfW with heat recovery equipment, and developing the infrastructure to distribute through a District Heating (DH) system, to be £10.1 million, with circa £700 k per annum for operation and maintenance costs. The recipient of the heat was future development around the Cooil Road area, much of which has since been developed. The assumptions made in this report are therefore to be reviewed by an EfW Technical specialist to provide contemporary information on costs and performance. It is understood that if the EfW was modified to enable heat recovery this would significantly reduce the efficiency of the EfW, reducing the amount of renewable electricity generated. Alternative uses for the recovered heat are also considered. This work stream needs therefore to be progressed following a detailed review by specialist engineers and energy advisers.

1.4. The EfW could, depending on technical consideration and costs, be retrofitted with the equipment necessary to recover heat generated through the combustion process. The heat could then be exported for use in a district heating scheme or locally for a specific industrial process.

1.5. In terms of its contribution to the net zero GHG target, as this DH scheme would be for new development, its GHG savings would not contribute to the target for reduction of current emissions. In fact as the DH scheme would require a standby heat source (AEA identifies the need for a 6 MW capacity fired boiler) which, if dependent upon fossil fuel, would potentially increase net GHG emissions.

1.6. Similarly due to the low value of heat energy, its use in a commercial development is unlikely to be economically viable unless cost of development is

subsidised, and the capex for retrofitting heat recovery to the EfW and annual operations and maintenance costs would need to be paid for by IOM Government.

Assess options for decarbonising the kerbside collection of residual household waste

1. EXECUTIVE SUMMARY

1.1. This workstream considers the carbon impact of residual waste collection by Local Authorities (LA). This could be considered alongside public sector transportation as a climate change topic. However as it relates to the provision of a specific statutory function, undertaken over 17 separate areas, without any standard for vehicles, collections or optimisation of collection rounds, it is considered to merits individual review.

1.2. There are no standards on the Island for kerbside residual waste collection. Each Local Authorities Waste Collection Area (LAWCA) service is specific to its area, delivered either in house or via a contractor. There is no optimisation of household refuse collection between LAWCA, each operating only within its political boundary. Households on the same road/estate can have different standards of service provision, and refuse collection vehicles rounds cannot therefore be optimised on the basis of geography and settlement profiles.

1.3. There is very limited contemporary data on LA waste collection schemes. There is currently 21 primary refuse collection vehicles (RCVs) registered for refuse collection. Only seven are Euro VI (European vehicle emission standard 6) and five vehicles were registered more than 14 years ago. Older vehicles are less fuel efficient, and lower the emission standards for their operation and annual vehicle check. This means they emit more greenhouse gases (GHGs).

1.4. The data currently available on RCV distance travelled/fuel used for refuse collection only is considerably out of date, and there is no data on the distance travelled to and from the Energy from Waste facility to unload. This data needs to be collected and analysed. The impetus for increased segregation of waste to allow for increased recycling will impact on the distance travelled for waste collection, particularly if this is via kerbside household waste collections. There are no proposals at present to centralise or regionalise refuse collection i.e. optimise refuse collection to reduce mileage. Calculating the carbon impact of refuse collections, and reviewing the vehicles used for current and future collections, is key.

1.5. One option, available through powers within the Local Government Act 1985, is for the Department of Infrastructure to set LAs minimum standards for delivering their respective waste collection functions. This could include a minimum standard (e.g. Euro VI/electric/hydrogen) that all RCVs used to deliver the LA refuse collection function by a target date (e.g. 2025). This would effect a reduction in public sector carbon and associated GHG emissions. It will also reduce air quality

pollutants (PM2 and PM103). Vehicles used for household waste collection are generally also used for commercial waste collections.

1.6. Recommended actions:

Liaise with Local Authorities to obtain contemporary data on refuse and other residual waste collection services and vehicle types. This will enable the carbon and CO_2e GHG emission for delivering this statutory function to be calculated and advise further discussion with LAs regarding:

- Opportunities to optimise collection
- transition to low carbon or electric Refuse Collection and other collection vehicles
- the introduction of standards for refuse collection.

Review the current fleet of vehicles (LA and contractor) used for refuse collection (residual, bring bank and kerbside) with a view to ensuring a minimum standard of Euro IV for all RCVs providing the statutory waste collection function by 2025. Based on current data on vehicle types and RCV costs, this would cost in the region of £3 million across all LAs based on purchase price of new vehicles.

Onshore renewables development phased with growing electricity demand

1. EXECUTIVE SUMMARY

1.1. Onshore renewable energy, in the form of wind and solar, are established technologies ready for deployment on the Isle of Man. Onshore wind now produces energy in the UK at a levelised cost of energy (LCOE) ~£45 per MWh, which is competitive against the marginal cost of electricity-from-gas. The electrical grid in the Isle of Man is capable of accommodating 20 MW capacity of onshore wind developments without significant grid reinforcements, with several sites suitable from a technical perspective previously identified by the Manx Utilities Authority (MUA) and others. Beyond 20 MW, the grid will require significant infrastructure investments as well as changes in operation modality to balance the intermittency with storage and demand-side flexibility, e.g. from 'SMART meters' (see grid reinforcement work package). Access roads to sites will likely require upgrades in order to allow deployment of large, more efficient, turbines where beach landing is not possible. The Isle of Man has the capacity to generate more energy from onshore wind than is currently demanded.

1.2. It is recommended that the Isle of Man clarifies the planning process for developers so that a pathway to planning and consent can be more easily determined and mapped. It is also recommended that a 20 MW development be announced through an 'expression of interest' in the first instance. A commitment to undergo a technical and economic evaluation of long-term grid reinforcement requirements is urgently needed in order to facilitate and commit to a strategic investment plan to accommodate more developments.

1.3. It is important to consider the role of the MUA Pulrose Combined-cycle Gas Turbine (CCGT) power plant with the phased introduction of renewable generation capacity. The spinning reserve that the CCGT provides is capable of balancing the intermittency of renewable generation. Alternative storage solutions exist for periods when excess power is being generated. Battery technology is being adopted throughout the world as well as the development of hydrogen technology as storage solutions, though incorporating these technologies will incur additional costs. In particular, coupling renewable energy with hydrogen production (electrolysis of water) is worth considering as more technical and economic data becomes available. Hydrogen fuel may be compatible with the CCGT plant in the future. For example, in the Netherlands, Mitsubishi Hitachi aims to run a 400 MW CCGT on 100% hydrogen by the mid-2020s. Hydrogen fuel could represent a natural transition opportunity for existing MUA infrastructure (Pulrose CCGT) to zero-carbon generation whilst also alleviating excess renewable generation.

1.4. As a technology, solar Photovoltaic (PV) has become exponentially more economic due to large-scale developments throughout the world. The levelised cost of energy is competitive and the MUA offer attractive feed-in-tariff rates for domestic and commercial installations, making it a viable opportunity for businesses and households to adopt the technology. However, installations above 50 kW face prohibitive 'reserve-demand-charges' that are currently a barrier to large businesses with significant scope for installations on rooftops or marginal land (unsuitable for other uses) to generate electricity. In terms of utility scale (MW) installations, the scope for solar to generate significant amounts of energy during high demand periods (winter evenings) is limited on the Isle of Man, even with storage. The technology may nonetheless provide generation benefits if deployed in areas with a low opportunity-cost (e.g. reservoirs, industrial and government rooftops, unused airfield space), alleviating generation demand from other assets during day-light hours in summer.

Establish framework for encouraging distributed domestic power generation

1. EXECUTIVE SUMMARY

1.1. The cost efficacy of various decarbonisation policies adopted in the UK during the period 2010 to 2018 were examined and revealed that carbon prices and large scale renewable subsidies were the most cost effective measure in delivering long term and sustainable carbon dioxide savings.

1.2. Small scale renewable subsidies proved to be the least cost effective. Current progress in the development of sustainable generation tariffs both on the Isle of Man and Ireland were investigated and the factors contributing to the success and failure of the Green Deal scheme in the UK are highlighted.

1.3. A simple framework agreement to encourage domestic renewable schemes for the Isle of Man is outlined but based on a recent UK's Ofgem report is not expected to be the most cost effective route to supporting the transition to a decarbonised economy. However it should play a dominant role in enhancing awareness, education and promotion of sustainability issues amongst the domestic sector and encourage Island-wide engagement and commitment to achieving a net zero emissions target by 2050.

1.4. An opportunity arises for other Isle of Man energy related utilities such as Manx Gas, EVF and Manx Petroleum to establish collaborative working partnerships, possibly with Manx Utilities Authority, along the lines of Energy Service Companies (ESCO). A comprehensive suite of products and services could be supplied to the domestic sector including energy management, low carbon heating, e-mobility, smart LED lighting services on a subscription basis as well as the opportunity to lease renewable schemes comprising solar PV, micro-wind and battery storage.

Strengthen electricity grid at key points

1. EXECUTIVE SUMMARY

1.1. Decarbonisation of the heating and transportation sectors on the Isle of Man will involve accelerated deployment of heat pumps (HPs) and electric vehicles (EVs) respectively. The increased electricity consumption and maximum demand will require major reinforcement of the Island's transmission and distribution system in the long term to 2050 if an accelerated strategy to net zero emissions is adopted. However for the next decade, current studies by a reputable UK consultancy – EA Technology - have indicated that modest investment costs are required to accommodate a 'zero carbon' trajectory comprising 10,000 EVs and 5,700 HPs by 2030. Moreover fully leveraging innovative adoption of principally dynamic tariff pricing structures and load management capabilities could reduce the potential cost of network investment. This is partly attributable to the 'loss' of electricity retail sales since 2009 providing some headroom both in electricity supply and transmission/distribution capacity to meet the majority of the increased load anticipated from the relatively high volumes of potential EVs and HPs over the next decade.

1.2. Widespread energy efficiency measures and structural changes in the Island economy has resulted in surplus generation from the existing Combined Cycle Generation Turbine (CCGT) plant and increased distribution network capacity at key strategic substations around the Island. Therefore the incremental electricity supply and network capacity requirements to accommodate aggressive EV and HP projections over the next decade to 2030 are expected to be met with minimum network expenditure.

1.3. In the longer term from 2030 to 2050 the impact on network reinforcement costs is anticipated to significantly increase due to the increased electrical load from a potentially exponential expansion in the deployment of EVs and HPs Island wide. However based on UK forecasts this is expected to be partly mitigated by a combination of alternative heating and transportation technologies and load management services offering system flexibility to defray substantial incremental network investments. Increased levels of domestic and commercial solar PV and thermal/battery storage – as the latter's prices continue to fall – will delay the need for major network reinforcement. Further support will originate from low carbon hybrid heating alternatives such as HP/'green gas' boiler systems, increased potential of vehicle to grid/home capabilities to facilitate aggregated load management services and dynamic electricity pricing tariffs to encourage usage at off-peak periods or times of surplus renewable generation.

Energy relationship with the UK

1. EXECUTIVE SUMMARY

1.1. There is an AC Interconnector (AC I-C) connecting the Isle of Man to the UK, which provides and gets electricity to and from the UK. To achieve net zero by 2050 will require the reduction of emissions from power generation. As emissions are accounted at the emissions source, i.e. in the country where the electricity is generated the export relationship with the UK should form part of any future considerations.

1.2. The interconnector is also used to import electricity and therefore decarbonisation could potentially be achieved by the Isle of Man becoming a net importer of energy. However based on current consumption the capacity of the interconnector would not be able to service the Isle of Man's current peak electrical demand so existing generation assets would be required. Particularly if the anticipated future take-up of electric vehicles and air-source heat pumps, for example, occurs.

1.3. Emissions from energy supply contributed to 24% of total greenhouse gas (GHG) emissions in the 2017 Isle of Man inventory. This relationship needs further exploration in terms of cost/benefits/CO_2 for import/export scenarios, with particular regard to emissions savings and security of supply.

Urgent leasing of blocks of seabed for offshore windfarms

1. EXECUTIVE SUMMARY

1.1. Offshore wind power represents the most abundant and commercially viable renewable energy source on the Isle of Man at present. Wind farm developers have already signed an agreement for lease to develop a 700 MW (annual output ~3000 GWh) wind farm on the east coast and have undertaken initial surveys since 2016. There has been no progress since then because renewable energy projects outside UK waters cannot bid in the UK Government contract-for-difference (CfD) auction rounds, the latest of which saw bids to develop offshore wind at a strike price of £39.65 per MWh (2012 prices). There is a barrier to development as there is no route-to-market available for the power generated so the developers are not able to make a final investment decision.

1.2. Until recently, discussions held with Ørsted (the developer, previously DONG Energy) were based on the premise that the power would be exported to the UK. With the ambition to decarbonise the Isle of Man electrical power generation and anticipated increased electrification of domestic heating and vehicular transport, there are several options for the development to consider where some, or all, of the power comes to the Isle of Man.

1.3. These scenarios, which are the result of high-level thinking among the Climate Change Analytical Team (CCAT), Ørsted and Department of Environment, Food and Agriculture (DEFA), are being further investigated. They pose additional economic and technical challenges and costs for the developer and the Manx Utilities Authority (MUA), which would purchase the electricity from Ørsted through a power-purchasing-agreement (PPA). All options will still require a change to the UK CfD legislation to enable the development, unless there is a significant change in the UK electricity market to enable PPAs or merchant agreements for offshore wind power.

1.4. Significant grid reinforcement on the Isle of Man would be required and balancing the intermittent generation from wind with the combined cycle gas turbine (CCGT), a Government owned asset that has significant contributions to the Bond Repayment Fund remaining and due in 2030 and 2034, requires further technical and economic analysis. Alternative balancing and storage solutions exist, such as battery storage and hydrogen production, which will require significant investment and are not evaluated here. Ongoing pilot projects that aim to couple offshore wind power and hydrogen through electrolysis may represent a solution within the next decade, whereby excess electrical energy from wind can be stored in the form of hydrogen. Hydrogen fuel is being used to power CCGT plants in the Netherlands, with 100% hydrogen CCGT power aimed for 2023, suggesting the

CCGT can avoid becoming a 'stranded asset' in the context of renewable generation.

1.5. Offshore wind represents an opportunity for public investment with attractive rates of return if sufficient capital can be invested after the construction of the project. Other developments in the Eastern Irish Sea are 50% owned by Danish pension funds, for example.

1.6. The Department of Infrastructure (DOI) and DEFA are in active negotiation about the options for progression presented herein. The Action Plan (AP) resulting from the Climate Emergency Transformation will inform these negotiations going forward. The UK CfD issue is highly unlikely to be influenced by the AP, since it is a UK Government decision.

Watching brief on tidal energy generation

1. EXECUTIVE SUMMARY

1.1. Tidal energy is favourable due to its predictability. Significant energy potential may be exploited from the large tidal ranges in the northeast of the Isle of Man (251 GWh per year) and the strong tidal streams at the Point of Ayre (19 GWh per year), Langness and Kitterland (not quantified).

1.2. Energy in high tidal ranges (>5 m) is harnessed by controlling the ebb and flood of the tide to create a 'head' of water, which is impounded behind an artificial sea wall. When the head of water contains the maximum gravitational potential energy, it is released through turbines to generate electricity. Conversely, tidal stream technology harnesses energy by mounting turbines to the seabed that convert the kinetic energy of the water column into electrical energy. Both technologies are capable of harnessing a 'baseload' of electrical energy for the Isle of Man grid.

1.3. Tidal stream technology is still in development, with levelised cost of energy (LCOE) at £300 per megawatt hour (MWh), though this is likely to decrease significantly as the UK creates financial mechanisms to support continued research and development and commercial trials. It is recommended that the Isle of Man maintain a watching brief on tidal technology as LCOE decreases and be ready to open expressions of interest to developers at the earliest opportunity.

1.4. Tidal lagoons, impoundment structures that harness energy from tidal ranges, are significant infrastructure projects that are capable of supplying energy for 120+ years. Tidal lagoons require significant capital investment. Due to the way projects are financed, lagoons require subsidisation in the short and medium term (£92.50 per MWh in Swansea), though it is argued they offer very competitive LCOE in the long-term (£7.80 per MWh in Swansea). There are no existing tidal lagoons generating power, though the technology is proven in estuary barrages. Several developments are proposed in the UK. It is recommended that the Isle of Man offer opportunities for developers to evaluate the capacity, cost and LCOE potential of tidal lagoons, despite UK developments failing to attract UK government subsidisation.

The role of Manx agriculture in the transition to the Isle of Man's net zero carbon emissions targets

1. EXECUTIVE SUMMARY

1.1. The Isle of Man has recognised the global climate emergency. To address the emergency, every sector will need to drastically reduce emissions to meet net zero emission targets. However, food production is essential and food security needs to be balanced with emissions reductions and the delivery of the Isle of Man's Food Security and Food Matters strategies.

1.2. The Manx agricultural sector accounts for approximately 11% of Greenhouse Gas (GHG) emissions on the Isle of Man (Aether 2019). Globally, the agricultural sector accounts for 10–12% of emissions (Smith *et al.*, 2007). Emissions from the UK agricultural sector represent 10% of UK GHG emissions (NFU, 2019).

1.3. The agricultural industry is fundamental in the transition to a zero carbon future. The industry is the majority land user/owner and manages the vast majority of undeveloped Manx countryside.

1.4. As the majority land owner/manager, the agricultural industry has the opportunity to maximise the potential of carbon sinks such as woodlands, peat land and soils on the Island. The sector itself needs to assist in offsetting harder to cut emissions from within the agriculture community.

1.5. Whilst it is evident that there is a global need to reduce meat consumption, the demand for meat and dairy continues to grow as more developing countries grow in affluence. It would be remiss not to consider that whilst demand continues to rise, the Island may be able to produce food at a more sustainable level than many other countries.

1.6. If the industry adopts a continuous improvement model with significant carbon sequestration options, there is potential to work collaboratively to explore and support carbon neutral practises within the industry, whilst responding to the climate emergency in a globally responsible manner.

1.7. This report has estimated that the sector could reduce emissions by 28.6% through changes to, among other things, soil tillage, reducing soil compaction, planting cover crops, increasing soil biodiversity, changes in fertiliser use, changes to livestock nutrition and increased health and fertility of livestock.

1.8. A number of potential systematic changes, management practices and emerging technologies which may permit a reduction in emissions within the agricultural industry have been investigated at a broad level. The initial research suggests that

further GHG reductions will occur through a natural diversification that includes (with suitable support) food production, renewable energy generation and land management for carbon sequestration. However all options outlined need further analysis to establish their GHG reduction potential and viability in the Manx agricultural context.

1.9. Much of the research in this field is developing rapidly and it is recommended that the Isle of Man follows progress closely so as to assess the effectiveness and economic viability of emerging research.

1.10. Any changes to the industry will require funding, which is likely to come from a variety of mechanisms. These may include, but are not limited to, public sector funding under current subsidies and new Agricultural Development Schemes (ADS), green funds, private and corporate offsetting schemes for increasing the carbon sequestration of habitats—including increased woodland on agricultural land—and investment for renewable energy generation etc.

1.11. An immediate assessment is recommended to establish how much farmland could viably be converted to carbon sequestering habitats and renewable energy generation without adversely affecting local food production, including assessing financial support mechanisms for the industry and potential emission reductions. Further work should be carried out to assess alternative systems and develop technologies that have the potential to further reduce emissions within the sector going forward.

Maintain gas grid until future decision on hydrogen generation by renewables

1. EXECUTIVE SUMMARY

1.1. The Island's gas grid is made up of a continuously piped natural gas supply and discrete clusters/ individual supplies of Liquid Petroleum Gas (LPG).

1.2. The grid is largely compatible with hydrogen distribution with the exception of several critical components such as:

- The high pressure pipeline that brings natural gas to the Island from the Scotland Ireland IC2 interconnector.
- The high pressure pipeline that carries gas from Glen Mooar to Douglas.
- The high pressure pipeline that supplies the Combined Cycle Gas Turbine (CCGT) at Pulrose.
- LPG storage tanks and road tankers are currently rated for LPG only.

1.3. None of the gas boilers currently installed on the Island are compatible with 100% hydrogen.

1.4. It may soon be acceptable to blend up to 20% hydrogen with natural gas for use in existing boilers.

1.5. Those parts of the network that are hydrogen compatible should last approximately 60+ years.

1.6. The UK Committee on Climate Change (UKCCC) have recommended that in the next decade a decision is made on the future role of hydrogen in the UK energy mix.

1.7. Hydrogen has the potential to perform many more functions than natural gas and LPG, such as fuel for transport, generating electricity and as a storage medium for intermittent electricity from renewables.

1.8. At present hydrogen can be produced on Island from indigenous renewable energy resources. If hydrogen alternatives to fossil fuelled technology become mainstream this could present the Island with the possibility of supplying its own energy needs for the first time since the industrial revolution.

1.9. Use of any parts of the existing gas network to export natural gas from the Island's territory would sterilise it for future alternative uses, i.e. transporting hydrogen.

Nuclear Small Modular Reactors

1. EXECUTIVE SUMMARY

1.1. A UK consortium, led by Rolls-Royce, has received UK Government backing to re-establish the UK as a leader in nuclear technology with small modular reactor (SMR) technology.

1.2. SMRs are designed to significantly cut Capital Expenditure (Capex) investment requirements compared to traditional large-nuclear by developing the construction base to roll out multiple identical 'units' with common components and design blueprints. The reduction in capex is expected to help achieve levelised cost of energy of £60-£75 per Megawatt Hour (MWh). For comparison, the levelised cost of offshore wind in the UK is now £45 per MWh, but has inherent intermittency issues. Each SMR unit will have up to 400 MW capacity (SMRs as small as 11 Megawatt equivalent (MWe) have been constructed, such as the EGP-6 reactor in Russia), with annual outputs of ~ 3,500 GWh per year. SMRs have improved load-following capability compared to traditional nuclear, with ramp-rates of 5% of maximum load per minute. For comparison, the total annual electric demand in the Isle of Man is 364 Gigawatt Hours (GWh) (2018), whereas demand for all fuels is approximately 1700 GWh per year (2018). A DC interconnector may therefore be required to export surplus electricity to the UK / ROI.

1.3. Nuclear SMR is said to be able to offer baseload supplies to remote areas of the grid. However, nuclear technology is not a renewable source of energy, depending on imports of Uranium- 235 (U_{235}) fuel. The fuel is not an indigenous resource to the Isle of Man and would likely be imported from Central Asia / Australia. The Isle of Man may face significant regulatory, environmental and political barriers to adopting nuclear SMR technology, though from a technical perspective, it offers long term (60 + years) infrastructure to supply stable electrical power in the context of increased electrification of surface transport and domestic heating.

1.4. In the pursuit of reaching net-zero CO_2, nuclear energy may offer a solution to increasing electrical demand in the Isle of Man. It is recommended that a watching brief is maintained on the technology and a national conversation on the technology encouraged to establish whether/how nuclear waste could be dealt with, and then gauge the level of political and public acceptability or support.

1.5. It should be noted that nuclear power is not usually considered compatible with UNESCO Biosphere Reserve designation, so this would be a significant consideration.

Direct Air Capture (DAC) Technology

1. EXECUTIVE SUMMARY

1.1. Direct Air Capture (DAC) is a relatively new technology that has been developed in North America and Europe. The chemical process extracts CO_2 directly from the atmosphere. The chemical process has been proven in small-scale trials and has recently succeeded in securing investment from industrial partners in the U.S., where oil producers are planning to capture 1 Mt (1,000,000 tonnes) per year at a levelised cost of $100 per tonne. DAC plants can be powered with renewable energy, creating significant opportunities to create 'negative emissions' in the Isle of Man carbon account.

1.2. The company Carbon Engineering (CE) have developed technology to chemically combine the carbon from the DAC process with hydrogen from electrolysis of water. The resulting compound is a synthetic fuel ('Air to Fuel'), which when burnt, releases ultra-low carbon emissions and is clean-burning. The synthetic fuel is claimed to be able to be produced at a cost of £0.80 per Litre (L), which includes the cost of the DAC process and electrolysis of water.

1.3. The Isle of Man currently consumes 55 million L of petrol and diesel per year, producing 162,000 tonnes of CO_2e. A CE DAC facility could capture offset the entire carbon account of the Isle of Man (839,000 tonnes) and produce sufficient synthetic fuel for the transport sector, with a 1Mt facility producing 320,000 L of synthetic fuel per day. The synthetic fuel can also be modified to be used as Jet-2 fuel and in home-heating.

1.4. It is recommended that the Isle of Man establishes contact with the DAC industry, particularly those in the industry that can create synthetic fuel as a by-product. The Isle of Man could represent a test-bed opportunity for the industry to trial the technology (with a relatively small and import-dependent liquid fuel industry), particularly since technology to decarbonise HGVs, marine and agricultural industries is not yet available. It will be important to enable DAC with renewable energy as a primary energy source in order to avoid a 'double-counting' exercise in the Isle of Man carbon emissions account.

Establish a date by which no new fossil fuel heating can be fitted

1. EXECUTIVE SUMMARY

1.1. Over a third of the Island's emissions come from the burning of fossil fuels in heating appliances (boilers and cooking appliances).

1.2. The UK Committee on Climate Change (UKCCC) has recommended that 'deep electrification' of heating is one of the core measures required to meet the UK's emissions targets, however, over the last ten years very little progress has been made despite the technology required being available. This is a good indication of how difficult it is.

1.3. There is no reason why alternatives to fossil fuels such as, heat pumps and solar thermal devices should not be used to provide heating in all new built properties.

1.4. For existing properties it is not as straight forward as simply swapping a fossil fuel boiler for an electric alternative.

1.5. Electric boilers can provide a direct swap for fossil fuel appliances but they have the highest running costs of all fuels.

1.6. Heat pumps have lower operating costs but can be significantly more expensive to buy and more disruptive to install than fossil fuel boilers.

1.7. For heat pumps to operate efficiently they require radiators to be changed or underfloor heating to be provided and where they replace a combi-boiler a hot water tank may be required, which adds additional cost and disruption.

1.8. Grid constraints, particularly older supply cables that provide power to rural properties, may mean that switching to electric heating is not possible.

1.9. If, in addition to electric heating, electric vehicle/s are also to be charged at a domestic property then a 3 phase supply may be required.

1.10. Liquid biofuel, such as Hyrotreated Vegetable Oil (HVO), could be used as a 'drop in' replacement for oil in existing systems but the sustainability of the feedstock is questionable.

1.11. Bio-methane produced from silage is explored as a viable 'drop in' option to decarbonise parts of or all of the gas network.

1.12. The potential for a hydrogen economy to develop complicates the picture and the possibility for using blends of biogas and hydrogen may play a role.

Explore the creation of a public/private delivery for domestic/commercial heat pump installation, targeting oil-fuelled premises first.

1. EXECUTIVE SUMMARY

1.1. The single biggest sector, by emissions figures, is heating of buildings.

1.2. A heat pump sounds complicated but is no different to a household fridge, (which is also a heat pump, in reverse) but in this case moves heat around and can be three times more efficient than an oil or gas boiler.

1.3. Heat pumps are likely to be an important part of meeting 2050 carbon targets.

1.4. Boilers have a lifespan of 15+ years, so a replacement rate per year of 2,000-2,500 could be expected, roughly half and half oil and gas boilers.

1.5. Key barriers to achieving the required level of uptake include cost, awareness, confidence, suitability and installer capacity.

1.6. There may be scope to develop a Framework Agreement route to procure air source heat pumps (ASHP), leveraging economies of scale for Public Sector Housing as was developed for the Ayre View trial (Bevan, 2009).

Restrict Fossil-fuelled Vehicles

1. EXECUTIVE SUMMARY

1.1. In order to restrict fossil-fuelled vehicle usage on the Island it is necessary for no new or second-hand fossil-fuelled vehicles—new to the Island—to be registered here after 2035. The inclusion of second-hand vehicles in this requirement is to ensure that the majority of the Island's fossil-fuelled vehicles have reached the end of their working life by 2050. Four fifths of vehicles registered on the Island are second-hand, and vehicles tend to be de-commissioned at 16-17 years of age.

1.2. A more ambitious timescale option is for no new or second hand fossil-fuelled vehicles—new to the Island—to be registered on the Island after 2032. A challenging programme of interventions will be required if the current electric vehicle (EV) target of 10,000 (15% of the Island's vehicle fleet) is to be achieved by 2030. A package of front-loaded monetary incentives for new and second-hand EVs would provide the initial market stimulus, supported by a combined range of policy measures. Revenue loss from hydrocarbon duties would be approximately £30m per annum.

1.3. The case for hydrogen-powered transport is likely to be insufficient for the Isle of Man, given its small size, and battery powered EVs are considered more appropriate.

1.4. Reducing the number of vehicles on the road in the first instance through reducing the number of journeys, providing greater use of more environmentally friendly forms of travel such as active travel (WP25) and public transport (WP14), then decarbonising the remaining fleet would be a more sustainable strategy to achieve reductions in the generation of direct and indirect greenhouse gas (GHG) emissions.

1.5. Curbing transport demand and a modal shift to cleaner transport modes will be important to reduce the amount of energy and other resources required to deliver zero emission mobility. However, demand reduction can only reduce emissions by a certain amount; it cannot achieve decarbonisation. Decarbonisation of the power sector will be a prerequisite for a zero emission transport system.

Explore the creation of business hubs to reduce commuting

1. EXECUTIVE SUMMARY

1.1. As more people are encouraged to work from home or work flexibly, business hubs can add value through offering opportunities for networking, collaboration and knowledge sharing.

1.2. There is a strong case for encouraging working hubs for the private and public sector as well as for self-employed individuals to reduce commuting.

1.3. Hubs have been identified as having the potential to play a role in removing or reducing the need for travel and commuting, in certain circumstances. Hubs also have the potential to improve work/home balance, wellbeing and engagement for the workforce.

1.4. Additional hubs located out of town and maybe near residential areas could also be encouraged to support and enable flexible and remote working.

Promote the use of Public Transport

1. EXECUTIVE SUMMARY

1.1. The challenge this report seeks to address is to reduce the volume of emissions from transport, specifically travel by private vehicle, through the promotion of public transport.

1.2. On the Isle of Man the primary form of public transport is a whole island bus service (Bus Vannin), provided by the Transport Services Division of the Isle of Man Government Department of Infrastructure (DOI).

1.3. A heritage railway does operate but journey times, cost and frequency make them unviable as regular public transport options as they exist today. A further piece of work to understand the operating costs and options available to develop the Isle of Man Railway network into a valuable public transport system should be undertaken.

1.4. The UK Parliamentary Report into bus services in England outside London, published in May 2019, reported that people's choice of transport is influenced by convenience, frequency, reliability, journey length and cost.

1.5. A sample research exercise undertaken in the Isle of Man provided an indication that residents identified with those same issues.

1.6. This report considers further exploration and action that may need to be taken to address these issues and any other barriers identified.

1.7. The improvement of real time customer information through personal digital devices and public digital screens at key bus stops would increase the level of information available for customers, complementing the existing telephone information line.

1.8. Ticketing information needs to be simplified and payment methods easier. Feedback has shown that it is not always clear how a passenger can pay their fare, and if they can use cash on a bus whether they must provide correct change.

1.9. Consideration should be given to how a simple and reduced pricing structure could encourage people to use public transport. Retaining the requirement to pay, but overcoming the barriers of a complex pricing structure and multiple methods of payment would reduce confusion for customers. Options include the introduction of a single travel card and the continued development of contactless card payments.

1.10. It may also be valuable to consider a trial or a campaign to measure the true impact of implementing free travel.

1.11. Timetable improvements could bring the greatest increase in passenger numbers, with feedback on the complexity and inconvenience of the current timetable indicating these are significant barriers.

Replace government transport fleet and all public transport vehicles with electric

1. EXECUTIVE SUMMARY

1.1. Government bodies need to lead by example in the drive to encourage the up-take of electric vehicles (EVs). The current availability of EVs suitable to replace fleet vehicles are light cars and vans, with new models being introduced to the market all the time.

1.2. The current Government policy regarding vehicle replacement is every 8 years, and an average of 78 small/light vehicles are replaced per annum.

1.3. The current additional cost of replacing a car with an EV is £10,000 for a car, and £40,000 for a van. This equates to a total additional fleet cost of £780,000 p.a. for the entire car and van fleet—based on the current cost of cars—although price parity with fossil fuelled vehicles is expected during the mid-2020s.

1.4. Both an electric bus fleet, and to a lesser extent, an electric Government fleet are modular systems, i.e. they require not just the vehicles, but also power supplies and charging points.

1.5. The installation of adequate charging facilities is essential for the roll-out of EVs across the Government fleet, as and when suitable vehicles enter the market. An additional cost per installation of charging point is in the region of £5,000.

1.6. Banks Circus is likely to be unsuitable for roll-out of the electric fleet due to infrastructure power challenges; an evaluation of the site should be completed as soon as possible.

Facilitate wider use of electric vehicles for private use including charging points in new buildings, more public charging points etc.

1. EXECUTIVE SUMMARY

1.1. This paper looks at how to facilitate the provision of infrastructure for electrical vehicle (EV) charging. Its central focus is on what the Isle of Man (IOM) can do in the coming years to lay the foundations for the transition to electric vehicles.

1.2. While it is recognised there will be a need for public charging points, there are already some works underway to facilitate this, with particular regard to visitor usage. It is likely that charging cars at home overnight using a dedicated chargepoint will be the primary way EV's are charged due to convenience for consumers, but other options must be developed. A target of at least 10,000 electric vehicles on Manx roads by 2030 has been set by Manx Utilities Authority (MUA). By setting long-term ambitions, a clear signal of the IOM's direction of travel can be set to provide certainty for industry and consumers. However, these ambitions need to be matched with actions. A fit for purpose infrastructure network will be key to this. A move to the mass adoption of ultra-low emission/electric vehicles means more infrastructure will be needed. The vision is for current and prospective electric vehicle drivers to be able to easily locate and access charging infrastructure that is affordable, efficient and reliable.

1.3. Other work packages have assessed potential take up of EV's, including incentives and other options to reduce emissions. This paper focuses on supporting the development the best electric vehicle infrastructure networks for the Isle of Man.

1.4. The transition to zero emission vehicles does not just require the vehicles to be available and affordable. An infrastructure network needs to be in place that is easy for current and prospective drivers to locate and use, and is affordable, efficient and reliable.

1.5. This paper proposes regulatory changes to facilitate this and ensure that both new and existing buildings are ready for such infrastructure changes. As the nature of the changes will be predominantly regulatory, a consultation is proposed to set minimum requirements for electric vehicle charging infrastructure in new and existing buildings with phased delivery.

1.6. There is also a need to consider how best to ensure all types of residential property owners are able to access a charge point for their EV's and are not disadvantaged on the basis of having communal facilities or not owning their own home. The level of provision around this needs to be explored in more detail.

1.7. It is recognised that there are works being undertaken to find the suitable sites for charging points and ways of publicising them. Some of the recommendations in this report would support this work going forward.

Establish active travel connectivity and target development along routes, building on the Department of Infrastructure Active Travel Project

1. EXECUTIVE SUMMARY

1.1. This report reviews active travel connectivity and the relationship between settlement patterns and growth direction as impacting on active travel and assisting a move from cars to alternative methods of transport, namely walking and cycling.

1.2. Direct emissions from transport result primarily from the use of fossil fuels. Direct greenhouse gas (GHG) emissions from transport were 0.162 metric tonnes CO_2 equivalent ($MtCO_2e$) in 2017 accounting for 19% of IOM GHG emissions.

1.3. The current Department of Infrastructure (DOI) Active Travel Investment Plan justifiably focuses on the Douglas area as this has the highest proportion of workers who live in the area. In any vision of a zero carbon Island there must be a shift from the car to more efficient forms of transport. This requires excellent infrastructure, much better integration between modes of transport and requires less dependency on cars. Demand reduction is a necessary part of meeting climate change targets.

1.4. Moving forward a greater understanding of distances and commuter travel patterns is required to enable the setting of more ambitious targets. For demand reduction, walking, cycling and public transport schemes must be promoted.

1.5. There is a need to ensure cycling and walking infrastructure opportunities are maximised in all planned infrastructure projects.

1.6. There are a number of strategies already in place to increase cycling and walking but they are spread over several Government Departments. Active travel is the first step towards smarter more sustainable transport options.

1.7. The long standing dominance of the motor car and the most recent figures showing a slight increase in private car use for travel to work, suggest it is likely that any strategies will require significant momentum to impact in the short to medium term.

1.8. To facilitate behaviour change, societal changes will be required. It will also be necessary to adapt planning of the projects and land use to minimise distances and maximise opportunities for walking, cycling and public transport.

Vertical Farming

1. EXECUTIVE SUMMARY

1.1. Vertical farming, which is a form of Controlled Environment Agriculture (CEA), is gaining significant investment worldwide. It offers the ability to grow crops such as leafy greens, salads, herbs and cannabis, in a highly productive environment by stacking modular hydroponic grow beds vertically and using specifically programmed LED lights. It is seen as an innovative way to use industrial spaces to grow food close to (or within) urban centres and a viable way for existing agricultural businesses to diversify.

1.2. The growing process is energy intensive, requiring significant amounts of electrical energy to power the LED lights. It is vital that CEA is powered by renewable energy in order to make a contribution to a net-zero agricultural sector. CEA farms can programme energy consumption to demand electrical energy at off-peak times. CEA can produce crops that would otherwise have to be imported, reducing the carbon footprint of produce whilst also increasing food-security for the Island.

1.3. Vertical farming represents an interesting opportunity in the Isle of Man, particularly where robotic automisation and software R&D may represent areas of growth for the economy. Although the domestic carbon account will not benefit from reducing the scale of imports of fresh greens into the Isle of Man (though certainly, reducing 'food-miles' will benefit the global carbon footprint of the food purchased), food-security among certain produce and economic benefits are apparent.

Create an efficient, low-cost marketing vehicle for local produce

1. EXECUTIVE SUMMARY

1.1. This report explores how Government can work with local producers to increase consumption of local produce, thereby decreasing greenhouse gas (GHG) emissions associated with food miles.

1.2. An assumption could be made that most members of the public would choose and prefer local food supply over imported food, because it is good for the overall economy, provenance and quality is assured. However, considerable work needs to be done to ensure customers are aware of what food can be supplied locally, the benefits of buying local, and working towards making local produce a realistic choice because it is competitively priced and easy to get hold of.

1.3. The Department for Enterprise (DfE) and the Department for the Environment, Food and Agriculture (DEFA) are committed to supporting growth and diversification in the local food and drink sector.

1.4. The overarching aim of DEFA's Food Matters Strategy is to grow the economic contribution of local food and drink on the Island from £75 million a year to at least £125 million by 2025.

1.5. Similarly schemes such as the Isle of Man Food and Drink Festival have made strides in raising public awareness in Manx Produce.

1.6. Agriculture and Fisheries Grants are also available from DEFA to help develop local businesses and support is also available from the Department of Enterprise with a range of schemes offering financial and practical assistance (see Annex A).

1.7. Outside of Government, the Isle of Man had a local Food Assembly that was modelled on the UK version. The local site was run through the parent website in the UK. When the UK website discontinued this ended the Isle of Man Food Assembly. Enquiries suggest the UK Food Assembly had not proved a success due to low take up. The Isle of Man, meanwhile, had the largest turnover in the UK and was achieving £7,000 a week up until the scheme ceased.

1.8. This report recommends the following actions:

- Work with the private sector to re-launch an Isle of Man Food Assembly – whilst the operation of the food assembly would be the responsibility of the private companies involved, Isle of Man Government could help to facilitate by allowing the online ordering system to sit on the Department of Environment, Food and Agriculture's Food and Drink website. There is also

potential to fund the website for a year which will both help to launch the service and also demonstrate confidence in local suppliers.

- Continue running the Food and Drink festival. As it is a popular event on the local calendar the Food and Drink festival attracts around 8,000 over the course of a weekend.
- Consider developing a Food Education Centre to promote agriculture and horticulture and local produce.
- Develop addition marketing campaigns for local produce, such as a 'Love Local' scheme and 'Buy Local' gift cards (in development).

Develop and agree policies to promote a circular economy

1. EXECUTIVE SUMMARY

1.1. In a circular economy minimal waste is generated as the surplus from one process becomes the raw material for another. Products are designed to be upgradable, easily disassembled and the parts put back into the economy. The longer products last the fewer are needed and the less carbon is required. As well as environmental benefits, a circular economy can support economic growth, creating jobs, encouraging community engagement, self-reliance and general health and well-being.

1.2. To achieve a circular economy, measures must be far reaching and cross-sectoral and for this reason it may be beneficial to use a flexible definition. Business models are an important part of facilitating a circular economy, for example around lease, sharing and other service based approaches. Adopting new business models relies on business participation and only can be influenced by Government.

1.3. A suggested definition for a circular economy which meets the local context of the Isle of Man is:

> "A circular economy is an alternative to a traditional linear economy (make, use, dispose) in which we keep resources in use for as long as possible, extract the maximum value from them whilst in use, then recover and regenerate products and materials at the end of each service life" (WRAP 2018; Bulkeley et al., 2007).

1.4. Government can play a key role in supporting the transition to a circular economy through awareness raising, supporting the development of a business case, and through grant support for example. Barriers can sometimes be mitigated through effective partnership working and genuine consultation, engagement and shared decision making and financing models.

1.5. Suggested actions to support the development of a circular economy include learning from transferable best practice, considering incentives and developing a regulatory framework to support compliance. This includes getting the right balance of government support, private sector innovation and economic activity.

Single use plastic policies

1. EXECUTIVE SUMMARY

1.1. Plastic pollution is a critical issue and one that negatively impacts the environment, wildlife and health.

1.2. The European Plastics Strategy states that plastics production and the incineration of plastic waste give rise globally to approximately 400 million tonnes of CO_2 a year.

1.3. Consumption of plastic is set to significantly increase over the next decade if no substantial changes are made. Given projected growth in consumption, in a business-as-usual scenario the entire plastics industry is expected to consume 20% of total oil production, and 15% of the annual carbon budget by 2050 (Ellen MacArthur Foundation, 2016).

1.4. In July 2018, the Single Use Plastic Reduction Plan for the Isle of Man Government was launched, setting out plans to significantly reduce single use plastic across Government. Sustainability champions within each Department are now taking this forward and driving change to substantially remove single use plastics across the public service.

1.5. In July 2019, the Single Use Plastics Reduction Plan for the Isle of Man Community was launched. The plan includes a legislative ban on certain single use plastic items in line with the European Union's Single Use Plastic Directive (EU Single Use Plastic Directive, 2018, in addition to various initiatives to engage and educate the wider community on the issue.

1.6. It has been estimated that the Government and community plastic plans could potentially result in a reduction of 3.5kg of plastic per person per year, saving approximately 928,642 kg CO_2eq per year. However, it is important to note this is a rough estimate as the resources (i.e. time/staff/finances) allocated for implementation of the plans will largely dictate their success.

1.7. It is also important to note that alternatives to single use plastic have their own carbon footprint. Understanding the impacts of alternatives has not been quantified in this report, but should be taken into consideration in future work, including in education and legislation.

1.8. Other strategies that have the potential to influence the amount of single use plastic used on the Island include the Food Matters Strategy, the Waste Strategy and the UNESCO Biosphere's Refill Scheme.

1.9. Influence from large off-island retailers (e.g. Tesco, Co-Op and Marks & Spencer) may reduce the amount of single use plastic used on the Island through changes in packaging policies. However most of the retail policies focus on moving toward more recyclable packaging, over a reduction in packaging. As the Department of Infrastructure (DOI) does not currently target food packaging for recycling, this may not help reduce carbon produced as it is all currently processed as general waste at the Energy from Waste Facility.

Embedding climate change and natural capital into procurement

1. EXECUTIVE SUMMARY

1.1. Climate change and natural capital (including geology, soil, water and biodiversity) should be central to any decision making process linked to procurement, if the Isle of Man is to achieve a net zero carbon Island by 2050. This consideration needs to be an integral part of any project and business case from the outset, including realising potential budgetary implications.

1.2. This change should be balanced against the overarching requirement for value for money (i.e. the monetary cost of the goods or services) which is often the decisive factor.

1.3. The feasibility of developing an Isle of Man Procurement and Commissioning Strategy should be considered, setting out strategically how the Isle of Man Government will use the mechanism of procurement to deliver on net zero carbon by 2050. This should be informed by an analysis (breaking down spend into headline categories) of where the carbon hotspots are across the annual procurement spend and the scope of influence to use procurement as a function and enabler to deliver net zero carbon.

1.4. The policy should be clear and simple, fully embedded in routine practices and procedures and those making procurement decisions will need to be fully aware of the issues and implications and have access to expert advice where needed. Developing a matrix approach as part of a wider strategy could support understanding and prioritisation of spend and actions including:

- Quick wins – opportunities for setting / mandating minimum standards.
- Marginal – low spend, low carbon (low priority).
- Campaign – high risk but marginal spend, and hence where Isle of Man Government will need to work with others to transform the market.

1.5. Departments, Boards and Offices will need to be fully aware of their obligations under any new policy. Departments, Boards and Offices are likely to be responsible for requirements and to ensure compliance these will need to be included in specifications drawn up.

1.6. Procurement Services can assist by ensuring that environmental issues are considered in the evaluation process, but do not have the authority to enforce. It is the Treasury who have responsibility for the current procurement policy.

1.7. Costs will include training for all staff and potentially suppliers including a basic online package for those with minimal exposure and more intensive sessions for

staff regularly engaged in procurement and contracts. An estimated £250,000 for the first year and £100,000 for the second year could be allocated to facilitate a tendering process and development and delivery of anticipated provision. This is a ballpark figure which could go up or down once the scale and specifics are agreed.

Emissions implications of aviation and shipping
Briefing note prepared for Isle of Man Government

1.1 This paper looks at some of the options around aviation and shipping. It is recognised that as an Island the Isle of Man is reliant on trade and visitors reaching them by sea or air and this can cause difficulties in mitigation emissions.

1.2 In terms of aviation the Highland's and Islands region of Scotland recently announced that it aims to be the world's first net zero aviation region. While the technologies for electric passenger flights are not yet in place Scotland hopes to be doing test flights by 2021. This work provides the opportunity for the Isle of Man to lower its short-haul emissions in a similar vein, if the nature of the flights is compatible. Research into sustainable alternative fuels, while not at the scale that would be required for the aviation industry, may present an option in the future.

1.3 In the UK it is estimated that 15% of the population take 70% of the flights, while this figure may be different for the Isle of Man a short term option to reduce emissions could be regulatory measures such as a reformed taxation regime for frequent flyers.

1.4 In terms of maritime emissions, while options for to fully decarbonise emissions are still developing, there are commercially available technologies and strategies to improve efficiencies. These include both hard (physical changes such as retrofits) and soft (behaviour changes) interventions.

Consider options for replacement ferries with lowest carbon technology

1. EXECUTIVE SUMMARY

1.1. The Isle of Man Steam Packet Company Limited owns two vessels, the Ro-Pax (roll on, roll off, passenger vessel) MV Ben-my-Chree and the HSC (high speed craft) Manannan, providing a lifeline ferry service to the Isle of Man.

1.2. With effect from January 2020, the emissions from the Ro-Pax ferry MV Ben-my-Chree should be reduced, when the Company is required to comply with the International Maritime Organisation's requirement to reduce the sulphur content of fuels from 3.5% to 0.5%.

1.3. Under the terms of the Sea Services Agreement, the Company is required to provide a new Ro-Pax vessel by December 2022, and specification and commissioning have already commenced. The new vessel is required to have the capacity to operate with either marine fuel oil or liquefied natural gas (LNG).

1.4. Although a number of alternative fuel technologies are available for reducing the GHG emissions of shipping, they are either not currently available for use or not sufficiently advanced to power a new Ro-Pax. However, inclusion within the vessel design of the option for dual-fuelling would potentially future-proof the propulsion system. Careful specification of the engine will however be required if it is to avoid the potential risk of greater greenhouse gas emissions from methane slip, which is when gas leaks unburned through the engine. If methane slip is not controlled, environmental benefits of using natural gas are reduced and can cancel out the advantages over diesel or bunker fuel due to the high greenhouse effect of the methane.

1.5. Alternative fuel technologies may be more developed in the mid-2020s, to coincide with the replacement of the current fast craft vessel in 2026.

1.6. Consideration should also be given to accommodating future low carbon fuel options in the design of the new ferry terminal at Liverpool.

1.7. Renewable electricity is a good method of decarbonising the auxiliary power needed by vessels and to power the ships whilst a berth in ports, instead of fossil fuel generators.

1.8. An alternative method for reducing emissions from the Island's ferry services could be to reduce the number of sailings, whilst ensuring that this does not inadvertently increase air travel emissions.

Cruise Ships

1. EXECUTIVE SUMMARY

1.1. Cruise ship visitor spend provides a valuable source of income to the Island, in particular to our heritage attractions.

1.2. Cruise ships are not thought to impact directly on the current emission reporting for the Isle of Man as they do not refuel on Island, but they do contribute to overall emissions and could impact on local air quality. However, the number of cruise ships visiting or stopping in Manx territorial seas has increased in recent years and a great understanding of what this means in terms of greenhouse gas emissions for the Isle of Man is required.

1.3. Cruise ships can be harmful to the environment in certain circumstances and this needs to be actively managed in accordance with international standards, considering the question of sustainability from a climate change perspective as part of any future decision making process.

Develop concept of net zero housing estates/developments (land and sea)

1. EXECUTIVE SUMMARY

1.1. Emissions from the residential sector accounted for 35% of total Green House Gas (GHG) emissions in the 2017 inventory. Therefore it is imperative that existing and proposed developments are part of reaching the goal of zero carbon by 2050.

1.2. Advancing net zero estates and developments for the Isle of Man will be very challenging. The challenge will be determining the definition of net zero carbon for the Island and the way in which buildings and developments demonstrate how a building has achieved net zero carbon status.

1.3. It is recognised that in most situations, net zero energy buildings and developments – i.e. buildings and developments that generate 100% of their energy needs onsite – are not feasible. Therefore, net zero carbon buildings that are energy efficient and supply energy needs from renewable sources onsite and/or offsite, are a more appropriate target for the mass scale action required to achieve the proposed reductions.

1.4. A decision needs to be made on what net zero development means for the Isle of Man and the required changes to the regulatory framework to achieve it.

1.5. There is the possibility for future requirements within Building Regulation and Planning Policy to drive energy efficiency and wider sustainability improvements for domestic new build and refurbishment, through the use of offsetting.

Develop a policy on sustainable urban drainage systems

1. EXECUTIVE SUMMARY

1.1. Surface water flooding is an increasing problem exacerbated by increased urbanisation, climate change and legacy poor drainage assessments in relation to both surface water and combined sewage infrastructure. Excess surface water in the sewerage system can lead to issues such as overflows and spills to the environment, as well as additional carbon emissions from pumping and treating surface water unnecessarily.

1.2. Excess surface water on the Isle of Man is largely managed through adapting conventional pipe based drainage systems to attenuate and restrict flow. Developers are required to ensure runoff post-development is at, or lower than, undeveloped greenfield runoff rates. Sustainable Drainage Systems (SUDS) are ways of managing surface water in a more holistic and sustainable manner. SUDS differ from conventional pipe based drainage solutions in that they do not only deal with issues of water quantity (flooding), they also take water quality (pollution), biodiversity (wildlife) and amenity (people) into account.

1.3. Due to this broader approach SUDS can also enable communities to cope better with the impact of climate change; for example: reducing and slowing surface water runoff, reducing the frequency and severity of flooding, greening and cooling the urban environment, storing water for reuse, and offering flexible infrastructure. SUDS can also help to mitigate climate change through carbon capture (sequestration)and by green infrastructure such as trees, green roofs, ponds and wetlands etc.

1.4. In order for the Isle of Man to gain maximum benefit from SUDS, it is recommended that a Government SUDS policy should be developed which may include the following principles:

- Surface water should be managed for maximum benefit;
- Surface water should be considered as a resource rather than a nuisance;
- Management of surface water should be equitable;
- SUDS should be considered at the earliest stages of site selection and design;
- SUDS should meet a minimum design standard;
- Planning policy should support SUDS policy;
- SUDS Hierarchy: vegetated SUDS should be promoted over non-vegetated SUDS, rainwater should be allowed to soak into the ground where possible, water should be controlled as close to source as possible.
- Surface water runoff should be managed above ground where possible;
- Development in existing urban area should be prioritised over green space development;
- SUDS should be sustainable in the long term;

- SUDS should be as safe as reasonably practicable.

1.5. The contribution of SUDS to carbon sequestration targets are likely to be small for both 'necessary' and 'high ambition' pathways (estimated as 0.1% and 0.24% of the Isle of Man total emissions budget for 2017 respectively), however the co-benefits of SUDS are significant. In addition to the water quantity, water quality, biodiversity and amenity, climate adaptation and mitigation SUDS can also contribute to health and wellbeing, recreation and education and bring benefits for developers.

1.6. In order to deliver a successful SUDS policy it will be necessary to establish an appropriately resourced adoption body (or bodies) with clear roles and responsibilities for developers, planners and those adopting and maintaining SUDS. The adoption body should set approval criteria and establish a process by which SUDS are adopted.

1.7. In the UK (with the exception of Scotland) SUDS have not been widely implemented due to a weak statutory position. The Isle of Man should avoid this situation developing by creating a robust legislative and planning framework for SUDS.

1.8. The design and construction guides *'Manx Sewers for Adoption'* (Drainage Division Department of Transport and Water Research Centre Plc., 2003), and *'Manual for Manx Roads'* (Department of Infrastructure, 2017) will need to be reviewed and updated to support SUDS policy and adoption.

1.9. The current Planning and Building Control regulatory frameworks should be reviewed to ensure that all the proposals align and maximise the benefit of the high level SUDS, i.e. requirements for effective catchment, wide surface water management and the development of new policy principles, where needed, or the expansion of those already in existence. A review of the Strategic Plan 2016 is proposed in 2020 as part of the Planning Action Plan which could include high level SUDS requirements.

1.10. To aid the delivery of water quality improvements through SUDS, water quality standards should be developed for receiving water bodies. For example the Isle of Man should consider adopting the water quality standards set out in the Water Framework Directive and SUDS should be designed to meet these standards.

1.11. To aid the delivery of biodiversity improvements SUDS should link with local biodiversity action plans where possible and access to any biodiversity funding should be made available to SUDS development where the biodiversity criteria can be shown to be met by SUDS.

1.12. Barriers to SUDS can include physical constraints of development sites, delays to planning, lack of community engagement, adoption and maintenance requirements, and health and safety concerns.

1.13. The costs (and returns) of SUDS will vary from site to site, however studies have shown that capital costs are typically on a par with, or lower than, conventional pipe based solutions. Maintenance costs are however, on average, higher than traditional solutions. There are a number of tools available to assess the whole life costs for SUDS schemes, such as SCOTSNET (2010) and B£ST (2019).

1.14. The development of a Manx SUDS policy supported by appropriately resourced planning, advisory and adoption bodies, is likely to bring multiple benefits to Manx communities, including improved flood risk management, climate change resilience, more visible and connected habitats as well as ecosystem services including carbon sequestration (see also WP5).

Environmental Taxes and Levies

1. EXECUTIVE SUMMARY

1.1 In the EU and UK green taxes have had varied success. Misapplication of some policies (e.g. EU ETS) contrasts against the realisation of the desired environmental benefits from others (e.g. Plastic Bag Tax). The Plastic Bag Tax is a good example of nudge theory, whereby behavioural change is encouraged through small economic penalties. However, most decarbonisation opportunities that could be encouraged through taxes/levies are more difficult to adopt and, at least at the moment, are rarely cost-neutral.

1.2 Successful implementation of new taxation policy requires that Government give citizens and businesses' sufficient time to adjust. The UK Landfill Tax was widely advertised and gradually implemented, allowing business time to plan and adapt. As with the Plastic Bag Tax, it was also widely recognised that simply dumping waste in a hole was not sustainable. The gradual implementation of an escalating tax gave the industry a clear signal and the confidence to plan investment. Conversely, the French experience with trying to catch-up on their frozen fuel duty escalator resulted in widespread rioting and a reversal of the policy. In contrast to taxation, financial incentives can also play a role in encouraging behavioural change, e.g. interest-free loans. 'Salix' (UK) is a loan where repayments are funded from savings in energy bills.

1.3 After decades of development, green tax policy thinking is now moving toward direct taxation of impact, whether that is represented by GHG emissions (or sequestration), or habitat degradation (or enhancement). This thinking is based on conventional free-market economic theory: once the price of goods and services includes their environmental costs, the economy will reorganise itself to operate in the most efficient way, only this time increasing environmental capital.

In collaboration with the private investment sector, establish mechanisms for funding the climate transition

2. EXECUTIVE SUMMARY

2.1. The total/estimated potential funding required for Isle of Man climate action and decarbonisation has yet to be determined in detail. In principle the funding could be apportioned between the Public Sector, Private Sector and/or via Public Private Partnership and will, to a great extent, be reliant upon the timescales upon which each of the measures proposed is required to be implemented i.e. how quickly funds can be mobilised, and potential for return on investment required by the private sector.

2.2. The UK Government Committee on Climate Change plan to achieve net zero greenhouse gas emissions by 2050 requires between 1%-2% of GDP. In the Isle of Man, 1% of GDP equates to approximately £50M per annum.

2.3. Given the magnitude of funding, public-private sector collaboration will be required. The Isle of Man Government may therefore seek to establish, for example, a Decarbonisation Fund and/or a formal "Green Finance Strategy" (and taskforce) to bring together the investor community with project developers to address finance challenges in key sectors. This approach could unlock and seek to accelerate green investment to deliver integrated solutions.

2.4. A review of actions already budgeted for and potential funds available will also provide clarity with regard to the private sector funding requirement and notify investors of potential lead times. Some projects will naturally lend themselves to private sector investment e.g. institutional investment in large scale sustainable energy infrastructure; or the provision of commercial loans/0% finance for home improvements and/or replacement boilers etc.

2.5. There is currently thought to be limited availability of reserves to fund climate action in the short to medium term, so other sources of funding need to be identified.

2.6. The initial reviews of existing taxes (Work Package 36-ii) and levies (Work Package 36b-iii) and measures which could be introduced indicates that changes, if feasible, are more likely to influence individual behaviours rather than generate significant or additional public sector funding; especially in light of potential tax losses from e.g. duty on fossil fuels from conversion to electric vehicles etc.

2.7. Isle of Man Government funding is currently available in the form of grants/loans – issued from Department for Enterprise (DFE), Department of Environment Food and Agriculture (DEFA) and Treasury/Cabinet e.g. for energy efficiency. The

effectiveness and take up of this funding is currently limited. In accordance with the Isle of Man Government Digital Strategy to minimise administration and Financial Regulations to provide value for money, it may be more efficient for such schemes to be administered centrally (i.e. irrespective of domestic or commercial consumers). One possibility would be for administration to sit within Treasury, as the Financial Provision and Currency Act 2011 provides the vires, including powers of Treasury to invest (provide loans and grants) and to promote wellbeing etc (Legislation.gov.im, 2011).

2.8. Discrete stand-alone initiatives can risk failure by being carried out in isolation, often gain little visibility, do not have sufficient impact to achieve their goals and do not attain sufficient momentum or attract enough other support to become self-sustaining. Fostering synergy among initiatives promotes the success and impact of grant programmes. Synergies are achieved through relationship building among grantees and with outside suppliers, sharing information and knowledge, sharing resources, combining efforts to yield greater capacity, joining voices to advocate for common goals, and spotting gaps in services offered and then filling these gaps.

2.9. Another potential advantage in centralising green subsidies, grants, finance etc is that it should improve visibility, transparency and better inform policy decisions and accelerate action.

2.10. Innovative ways to harness additional funding from, for example, Green Funds and Carbon Offsets have also been explored. However, in order to make a serious impact it is evident that an enormous amount of investment is required. The Isle of Man Government will be required to finance schemes which are naturally commercially unattractive and invest in accelerating climate action in difficult to reach areas like adaptation and resilience.

2.11. Reliance on Isle of Man Government public sector funding will be insufficient to meet the investment needed for environmentally sustainable growth. Interventions should therefore focus on mobilising private finance and removing market barriers to investment.

2.12. The competitive position of the Isle of Man, in particular with our closest and direct competitors, must be balanced against global action in light of the various constraints imposed on the Island through its own statutory enactments and its relationship with the UK Crown as a Dependency.

2.13. Work is underway to determine interdependencies of climate action options, and the resultant demands on finance, requires due consideration and completion in order to determine potential funds flow and is now essential. The most efficient, effective and economic means of mobilising funds to meet individual action tipping

points requires mapping given the urgency of addressing climate change has now been acknowledged.

2.14. In its pursuit of continued income and economic growth, it will become essential for zero carbon concepts to be embedded in government policy and used to determine the eligibility for and allocation of funds e.g. future grants, loans, subsidies. For example the provision of financial assistance to business to create/encourage economic growth should include an assessment of the carbon impact of such funding, including potential carbon emissions caps and mandatory offset requirements.

Review of direct tax opportunities and implications for a net zero IOM

1. EXECUTIVE SUMMARY

1.1. This paper looks at:

- What international tax policy makers are advising in respect of climate change
- What are the Isle of Man's closest neighbours are considering
- How to design relevant direct tax incentives/disincentives for the Isle of Man

1.2. The only direct taxes in the Isle of Man are Income Tax and National Insurance.

1.3. In the Isle of Man direct taxation policy has been underpinned by three key principles for almost 20 years, these are:

- Fiscal sovereignty
- Economic stability
- Adherence to International Tax Standards

1.4. It is assumed that any new direct tax policies to address climate change would also need to abide by these principles.

1.5. Tax incentives are deductions, exclusions or exemptions from a tax liability offered as an enticement to engage in a particular activity or to encourage a particular behaviour. A tax disincentive is the reverse, it is a tax charge or similar designed to discourage a particular activity or behaviour.

1.6. Corporate income tax incentives are normally used to promote research and development activities, export activities, and support the competitiveness of their enterprises in the global market as well as to attract foreign investment and foster national industries. Individual income tax incentives typically address things like encouraging saving for retirement.

1.7. As the only direct taxes in the Isle of Man are Income Tax and National Insurance the only direct tax incentives that can be considered in the Isle of Man relate to these two levies. Direct tax disincentives could in theory also include new direct taxes.

1.8. In addition there are important factors to consider in connection with the use of direct tax initiatives to bring about behavioural change.

1.9. The Isle of Man's ability to provide tax incentives is restricted by the fact that it already has a narrow direct tax base and low rates. For example most companies do not pay any income tax therefore it is very difficult to incentivise them by reducing their income tax liability.

1.10. The ability to provide tax incentives is also obviously restricted by the need for the direct tax system to generate sufficient revenues. In short, the more tax incentives reduce tax revenue the less money is available to provide public services.

1.11. Using direct tax as a disincentive i.e. imposing new direct tax charges should not be considered a revenue source as the policy objective is to stop the behaviour. If the measure is successful it should not generate any income as the behaviour will have been stopped.

1.12. The efficacy of providing an incentive via the income tax system is also a factor. For example, providing an income tax incentive to insulate your house may seem logical but if those that have not insulated are on low incomes they may not be paying tax or the value of the incentive may be lower as they are only paying a small amount of income tax. In these cases direct grants maybe a more effective way of providing the incentive.

1.13. More generally, best practice requires that any new tax incentive is measured and reviewed for its effectiveness by looking at whether it is in fact achieving the desired policy objective.

1.14. Opportunities - the first step is to consider what behaviour it is desirable to encourage or discourage. The following have been identified so far but there may be others:

- Discourage the ownership and usage of petrol/diesel cars or those with higher CO_2 emissions
- Encourage the ownership and usage of electric cars or those with lower CO_2 emissions
- Encourage other forms of transport with lower CO_2 emissions e.g. cycling, public transport
- Encourage more efficient ways of home heating/reducing the need for home heating

1.15. The second step is to identify possible direct tax policies that would encourage/discourage these behaviours.

1.16. There is existing tax measures/incentives which can be expanded and become more focused as part of a package of measures. For example, a number of exemptions exist for reducing income tax and national insurance liabilities and encourage better forms of transport such as the cycle to work scheme, benefit in

kind (BIK) exemption for electric cars provided by employers to employees. This could easily be expanded to encourage travel by other forms of transport for example a BIK exemption for public transport costs and higher BIK charges for cars.

Review of levy/import/export opportunities and implications for a net zero Isle of Man

1. EXECUTIVE SUMMARY

1.1. This paper reviews the options of utilising the Island's indirect taxation system to introduce new levies; import or export arrangements etc. that could assist the Island in achieving net zero carbon.

1.2. The paper highlights the opportunities and implications of introducing the environmental taxes that are currently in place in the UK and which are specifically managed through HMRC's indirect taxation system. These are: Climate Change Levy, Carbon Price Floor, Aggregates Levy and Landfill Tax.

1.3. However, it should be noted that the existence of the 1979 Customs and Excise Agreement prevents the Isle of Man Government from deviating from UK duty rates for any of the duties defined as 'common duties' under the Agreement; this includes all hydrocarbon duties and customs (import) duties.

1.4. The paper concludes that whilst there are definitely some opportunities available, the Isle of Man Government will need to exercise caution to ensure that the longstanding revenue sharing arrangements that the Island has in place with the UK, would not be put at risk/contravened as this could result in the Agreement being withdrawn. However, the introduction of an Isle of Man based carbon tax could be considered.

Evidence Gaps

1. EXECUTIVE SUMMARY

1.1. During the process of working on the work packages to inform the climate action plan report, numerous areas for further work were identified. These include further research required to understand the current situation, modelling to understand future scenarios and monitoring that needs to be implemented.

1.2. This list is an initial attempt to bring these evidence gaps together, but further work is required to identify the key gaps and to prioritise them for delivery.

1.3. They have been grouped into the following categories;

- Funding and Finance;
- Infrastructure;
- Research;
- Monitoring and Mapping;
- Education and Implementation;
- Waste & Other Greenhouse Gases; and
- Further Emission Reductions.

It is important to note that the knowledge gaps identified should not be taken out of context and readers are advised to read the related appendix for further clarity. The knowledge gaps do not necessarily indicate a decision to progress with a particular project, and only recognise missing information which should be investigated at a later stage.