

THE ECONOMIC IMPACTS OF CLIMATE CHANGE ADAPTATION

SECTION 1 - INTRODUCTION

This paper is submitted on behalf of the Climate Change Adaptation Sub Group and reports on the economics of adaptation.

Compared to many parts of the World, including parts of the UK^{i,ii} Wales is less vulnerable to some of the major predicted impacts of climate change, including coastal flooding and droughts. Nevertheless the threats posed to Wales by climate change are very considerable and will have major economic impacts as a result of, for example, potential land loss and disruption of the vital infrastructure on which all modern economies rely. Economies that are prepared and adapted for climate change will be better placed to cope and thus to remain competitive when the impacts of climate change become more acute.

At the same time as preparing for climate change impacts, Wales will be transforming into a low carbon economy to meet the Welsh Assembly Government's aim of achieving annual carbon emissions reductions of 3% by 2011ⁱⁱⁱ and the UK Government's recent commitment to cutting the UK's greenhouse gas emissions by 80% of 1990 levels by 2050^{iv}. A strong, sustainable economy is likely to be better able to afford to invest in adaptation and mitigation measures but must simultaneously reduce global emissions to minimise the impacts that threaten the world's poorest and most vulnerable communities.

As illustrated at Section 3 of this paper, there are likely to be major impacts on the Welsh economy arising from climate change. Section 4 explains that, whilst there are exceptions, it seems unlikely that much of Welsh industry has considered how their businesses will be affected. This prompts various questions; see Section 5. In the final part of this paper (Section 6) a number of recommendations are made as to how the Welsh economy might move toward adaptation, led by the Welsh Assembly Government.

In considering any adaptation plan it is important to understand the balance between risk and affordability: we want a plan that we can afford today that provides appropriate protection against risks today and in the future. However successful we are in reducing emissions, impacts are likely to continue to increase over the next decades because of historic emissions. There needs to be an acceptance that we are unlikely to be able to afford to prevent some of the impacts of climate change. We therefore need to identify the best options to enable us to adapt to climate change at an acceptable cost to our population, our economy and to the environment of Wales.

In considering what costs are acceptable, we must recognise the responsibility that falls on our generation. Unless we take decisive action over the next 20 years, including appropriate adaptation measures, the world we bequeath to future generations will be significantly damaged and could become a hostile place to live in compared with current standards. These actions will have to be paid for. People, including the people of Wales, must therefore begin to value properly the ecosystem services that are now taken for granted and question the perceived accounting wisdom under which future benefits are seemingly intrinsically worth less than current ones.

This paper assumes an economy along the lines of the existing global economic model. However, there are members of the Adaptation Sub Group who question the future validity and sustainability of this model and, in particular, the desirability of further economic growth. They point out that existing

industrial societies (and the growth in economic activity that they have achieved) have been based heavily on fossil fuels. "Economic activity" is seen as a process for turning natural resources and human labour into growth and increased welfare and therefore it contributes to climate change. No country in the world has yet successfully de-linked the two. Looking ahead, Governments will need to take greater account of greenhouse gas emissions in inventories for economic growth. The Annex to this paper has been prepared by the Worldwide Fund for Nature to provide an alternative view on some of these issues and to outline why economic models may need to be looked at more critically by the Climate Change Commission and its Sub Groups.

SECTION 2 - RECOMMENDATIONS

Recommendation 1. Left to their own devices, market forces are unlikely to deliver the full response required to deal with the challenge of climate change. The Welsh Assembly Government must assume a leadership role in the delivery of climate change adaptation in Wales.

Recommendation 2. Affordable, appropriate and reasonably robust climate change adaptation measures must be mainstreamed into Welsh Assembly Government strategic policy documents and resulting policies and measures, including its procurement policy. Its sponsored bodies should follow its lead.

Recommendation 3. The Welsh Assembly Government should liaise closely with Whitehall and other agencies regarding UK climate change adaptation, including resilience planning. In particular, the Assembly Government should encourage the Treasury to consider fiscal measures, such as tax relief on adaptation measures.

Recommendation 4. The Welsh Assembly Government and its partners should continue research to improve the understanding of the costs and wider impacts of climate change on the Welsh economy.

Recommendation 5. The Welsh Assembly Government and its partners should disseminate a readily understood version of UKCIP08 and other useful information to relevant organisations in Wales and should promote tools like the ‘adaptation wizard’ to Welsh business. Data and information about climate impacts (such as flood risk maps) need to be of high quality and widely available.

Recommendation 6. The Welsh Assembly Government should use its influence to persuade Welsh business of the business case for climate resilience, assist business with the development of sustainable, resilient strategies and support industry in seeking innovative business opportunities arising from adaptation. Its “All Wales Green Jobs Strategy” should enable the Welsh Assembly to formulate and promote its policy in this area.

Recommendation 7. The Welsh Assembly Government should encourage agriculture in Wales to plan for the impacts of climate change. Assuming it would be permissible under European rules, the Welsh Assembly Government should consider using its financial assistance to encourage agriculture to take measures that will contribute to adaptation.

Recommendation 8. The Welsh Assembly Government should continue to use its development planning functions to encourage the delivery of climate change adaptation. If and when the Building Regulations are devolved, they will also provide a useful tool for this.

Recommendation 9. In line with guidance from the Welsh Assembly Government, unitary authorities in Wales should use their functions to encourage the delivery of climate change adaptation.

Recommendation 10. Given the economic importance of modern infrastructure, the financial regulators of the power, telecommunications and water industries must ensure that their industries commence appropriate climate change adaptation measures. and have sufficient funding to do so

Recommendation 11. In adapting to the impact of climate change, the Environment Agency and Countryside Council for Wales should continue to exercise their statutory duties to protect the natural environment, in a way that meets statutory obligations, is scientifically robust and does not impose excessive costs (in relation to benefits gained) on regulated organisations or on society more widely.

Recommendation 12. Major trade associations, the farming unions, professional bodies etc should spread the adaptation message to their members and point them in the direction of further support and disseminate examples of best practice.

Recommendation 13. Greater efforts should be made to inform the public about climate risks. Individuals should use their spending power to encourage adaptation by business

Recommendation 14. The relationship between current economic models and climate change – in terms of mitigation and adaptation - requires critical evaluation by the Climate Change Commission.

SECTION 3 - THE ECONOMIC CASE FOR ADAPTATION

Today's global economy is founded upon trade and a nation's economic success is built upon its ability to trade successfully using the natural and human resources at its disposal. For a national economy to grow it needs, and competes for, access to resources and markets. Climate change, resource depletion, population growth and ecological limits all challenge the economic growth paradigm, and the implications of continued growth must be a central part of the debate about climate change mitigation and adaptation.

Climate change is also a global phenomenon, so we should consider the impact upon Wales of changes in the global environment and, in particular, how Wales can maintain a successful, sustainable, resilient and competitive economy through the consequential changes that are likely to occur.

Given the global supply chain, impacts abroad (e.g. disrupting the supply of raw materials) are likely to be felt by, but be largely beyond the direct control of, the Welsh economy.

Adaptation actions generally mean spending money now to prepare for different, but uncertain, circumstances in the future. Adaptation measures may entail significant costs to those providing them, e.g. the costs to water companies, farmers or other industries of providing additional water storage if demand management measures prove inadequate: these costs will, in turn, have to be borne by their customers and so may have an adverse economic impact. Because there is cost incurred in adapting to change and uncertainty in the value of any investment made to adapt, the overall economic impacts of climate change adaptation are generally perceived as negative.

It has been suggested that adaptation action taken now by Wales could hamper the competitiveness of Welsh business and its wider economy in the short term if similar measures are not taken by the rest of the UK, the EU and beyond. Against that background, it is helpful that the European Commission has acknowledged that *“Certain sectors, such as agriculture, water management, biodiversity protection and fisheries, are largely integrated at EU level through the single market or common policies. It thus makes sense to integrate adaptation goals into these sectors, as well as into EU spending programmes, for instance on regional development, agriculture, fisheries, social, research*

and rural development.”^v Following a Green Paper published in 2007 on “Adapting to climate change in Europe – options for EU action”^{vi}, the Commission plans to produce a White Paper early in 2009. The European Environment Agency has also said that “Adaptation has an extremely important role in reducing the economic costs of climate change across Europe. While adaptation has a cost, it significantly reduces the residual costs of climate change. However, there is currently very little quantified information on these costs, and further work is urgently needed to build the evidence base to facilitate informed, cost-effective and proportionate adaptation.”^{vii}

One of the main messages arising from the Stern Review is that early action on both adaptation and mitigation is likely to be highly cost-effective in the long term. We also recognise that adaptation measures taken early could put Welsh companies at a significant competitive advantage. To quote from a Met Office report, “Businesses that are the most resilient will have an implicit lead when their local, national or international competitors fall prey to the environmental impacts of climate change.”^{viii}

Unless adaptation measures are taken in time, climate change will have an adverse impact on Welsh industry and the wider economy in the future in a variety of ways. Some climate change risks such as flooding or storm damage can happen suddenly and with little warning. Other risks such as changes to soils and growing season will be slower in their effect, but could have equally large economic impact. The following paragraphs describe some of the impacts in more detail.

A **warmer, drier climate** will reduce river flows and is likely to increase demand for water. Any extended period where there is less rain than expected can cause a drought. The supply of adequate drinking water supplies to the human population is of primary importance. Therefore, if other demand management measures do not reduce water use sufficiently, there are provisions available^{ix} in severe droughts that allow for restrictions to be placed on non-essential use of water and for taking additional resources from the environment. The ready availability of sufficient water is essential for economic activity (and the health of the natural environment): such restrictions would have economic impacts upon some specific businesses (e.g. golf courses and car washes) and would leave less water available for other users including agriculture and the environment. A warmer, drier climate will also increase fire risk. Diseases that are currently confined to warmer climates may become more widespread which, in turn, may impact on the economy (e.g. loss of workforce and cost of healthcare) although there may be fewer deaths from cold exposure. Business accommodation could become difficult to work in for large spells during the summer without additional air-conditioning. Hot summers will increase soil drying and subsidence damage to properties that are not properly underpinned.^x

As demonstrated during the summer of 2003, **extreme high temperatures** can take a heavy toll in terms of human health. A Met Office report^{xi} notes that, “the first significant climate event to be studied and attributed to global warming was the summer of 2003, a one in 1000 year event that will likely happen every other year by the 2040s^{xii}. In Paris, 3000 people died in one night and in London the mortality rate temporarily doubled for the elderly. There were \$15bn of total losses due to wildfires and drought^{xiii}.” As well as the toll on human health, such temperatures can damage infrastructure such as railway lines, roads etc.

The 2007 **flooding** incidents in England illustrated very well the vulnerability of key infrastructure – in that case, power supply, transport links, water and sewage treatment – to sudden flooding incidents. The economic impact of such events can be felt far beyond the local vicinity: the loss of Mythe Water

Treatment Works in 2007 left 350,000 people without drinking water, while the potential loss of power in Sheffield would have seen 750,000 people, plus industrial users, without electricity. The dam at Ulley Reservoir, near Rotherham, nearly failed and motorway closures affected eight motorways, with many other roads also disrupted, and several railway lines and stations were closed^{xiv}. The floods caused projected insurance claims in excess of £3bn (ABI, 2007) which does not include indirect costs (e.g. medical services), nor harder to quantify costs such as the disruption to families and schooling.^{xv} The **other extreme weather** events being predicted as a result of climate change, such as severe storms and high winds, also have the potential to damage infrastructure and buildings and, for example, sudden downpours of heavy rain may devastate crops and cause soil erosion.

Rising sea levels are likely to take economically productive land in the coastal zone out of use if its continued defence becomes wholly uneconomic in the face of climate change, including the settlements, infrastructure and industry in those areas. It is in coastal zones that some of the most challenging adaptation questions for society will be highlighted, including questions of equity and livelihoods. Rising sea levels may also lead to saline intrusion into some freshwaters and aquifers.

Climate change may eventually lead to **human migration**. If, for example, under climate change the south of Spain becomes too dry and hot to live in, or the east of England suffers from sea level rise, people will start to move to Wales because it is a better, less uncomfortable place to be. This could be good or bad for the economy. It could provide labour and investment for the economy, but if unplanned for, it could place unacceptable burdens on infrastructure and support services.

Turning to **wider impacts on the economy**, climate change is, as noted above, likely to have an adverse impact on the health of the population which would lead to an additional major burden on the health service. Repairing damage to key infrastructure such as roads and maintaining flood defences will also fall to the public purse. It is inevitable that most measures to protect the natural environment, e.g. the provision of environmental corridors to improve ecological connectivity and thus help species to migrate, will be funded by the tax payer, either directly or through subsidies. There may be a need for state assistance to help some poorer sections of the community to adapt (see below). A strong economy will be needed to support this public investment through taxation.

It is estimated that Organisation for Economic Cooperation and Development member countries spend \$1.5 trillion annually in construction of new buildings and infrastructure. The additional cost of making new infrastructure and buildings resilient to climate changes could be \$15-150bn each year (0.05-0.5 % GDP). Retrofitting the built environment is much more expensive or prohibitive not to mention the disruption to ongoing business^{xvi}. It is also estimated that \$3.15bn spent on flood control between 1960 and 2000 has averted losses that would have been of the order \$12bn^{xvii}.

Despite the best efforts of the conservation bodies, there will be impacts on the **natural environment**. There is a significant intrinsic value in biodiversity and species conservation: although its value is largely intangible, the Valuing our Environment Partnership has done a considerable amount of work to identify monetary values of the Welsh environment. It estimated that £6 billion of the Welsh gross domestic product (GDP) is directly dependent on the environment: that is around 9% of Welsh GDP. It also found that some 1 in 6 Welsh jobs are supported by the environment and that annually it contributes £1.8 billion in wages to the Welsh economy^{xviii}. An initial scoping “*Wildlife Economy Wales: An Economic Evaluation Scoping Study, 2007*” has also tried to understand more about the nature and scale of wildlife-related economic benefits to Wales^{xix}.

The natural environment is economically important because, for example, of water resources, agriculture and tourism and a host of ecosystem services not priced in the marketplace. By way of illustration, the loss of a natural resource such as a fishery (and Wales boasts a number of important fisheries, contributing more than £100 million per year to the economy^{xx}), leads to a loss to the economy from tourism, recreational use and food production. Adjustments made by agriculture to adapt to climate change may also impact on the natural environment.

While much is uncertain about the resilience of the natural environment to climate change, it is generally accepted that there is a need for a precautionary approach to be adopted to protect important habitats and species. Where there is a commitment to protect a species or feature of the environment from climate change impacts, there may be a cost to do so, e.g. choosing not to take drinking water from a particular river during drought means a more expensive source will be used, or restrictions on water use will be introduced which will have an impact on business. A separate sub group is considering the adaptation issues for the natural environment: in doing so, it will need to be mindful of who is to pay for such adaptations and their affordability.

Decisions by **individuals** with regard to climate change adaptation are likely to be at a household level and market driven. For example, the ‘insurability’ of houses in flood plains and coastal areas may become a downward influence on house prices. Poorer sections of society may not be able to make economic decisions in relation to climate change, e.g. they will not be able to afford to move out of a flood risk area, or insure against flood damage. There may therefore be a case for minimum standards of adaptation being set by government policy and paid for by society in general. This becomes more acute in times of economic difficulty.

SECTION 4 - WILL WELSH INDUSTRY ADAPT WITHOUT INTERVENTION?

Some sectors may adapt with little or no intervention. **Agriculture** has always had to react to, for example, changes in the commodity prices for its produce. It has been predicted that the warmer climate and longer growing season will enable UK agriculture to diversify into crops such as olives and grapes. Nevertheless, the industry is likely to require, at the very least, support and guidance. Financial support may be needed to help farmers to adjust and to encourage them to introduce adaptation measures for the wider good (see section 6 below). Agriculture also relies on the availability of water: as the provision of drinking water supplies is of paramount importance it may be that other users of significant quantities of water, including agriculture, will have to adjust their abstractions – or their crops/numbers of livestock - in the event of water scarcity. Rising sea levels are likely to lead to decisions not to defend some tracts of the coastal zone from inundation, decisions which are (understandably) likely to be resisted by local agriculture. Agriculture may well have to adapt to climate change at the same time as it makes its own contribution to reducing greenhouse gas emissions, for example through reducing the use of fertilisers and numbers of livestock.

The **tourism** sector may benefit, at least initially, from climate change and may adapt with little intervention. The industry is a major contributor to the Welsh economy (estimated at £3bn a year)^{xxi} and this is, in part, because of the high quality of much of the Welsh environment, including its coastline. Adverse impacts on the environment, particularly the loss of the existing coastline as a result of climate change or deteriorating bathing water quality, could damage this industry, and so may be resisted by tourism representatives. (It is noted that a study into the impacts of climate change on the tourism and recreation sector in Wales is in hand.)

Given its total reliance on the water environment, the **water industry** is already planning ahead. For example, Dŵr Cymru is seeking to embed climate change adaptation (and mitigation measures) into its business planning, including, for example, in its strategic direction statement, “Our Sustainable Future”^{xxii} and its draft Water Resources Management Plan both of which look ahead twenty-five years. The company intends to spend over £130 million during 2010-2015 on installing enhancements at twenty-three water treatment works as changing weather patterns are already affecting the quality of some of the “raw”^{xxiii} water the company abstracts. Nevertheless, as noted above, future droughts will mean that everyone, including industry, will have to learn to live with less water and potentially invest in more water storage. For this reason, the Environment Agency is advocating a twin-track approach, whereby water companies utilise demand management before developing new supply options in their Water Resources Management Plans. Dŵr Cymru is also already working with the Environment Agency to understand where its key assets most at risk of being flooded are located and is acting to protect key assets that are vulnerable to flooding from rivers, surface water or rising sea levels: during 2010-2015 it plans to invest £5m to protect those most vulnerable assets.

But these industries are probably the exception. Unless, for example, they are located somewhere already prone to flooding, **most companies** are probably still unconcerned about climate change impacts, or consider that the burden will fall to the public purse through flood defences etc. To quote from a report published by the Met Office^{xxiv}, “*The Carbon Disclosure Project has collected significant detailed information about sector preparedness...Some sectors are clearly in denial (although this data may already be out of date) even though they are likely to be significantly impacted by climate change in the near term. This includes the real estate sector where 90% of respondees have expressed little or no concern about climate change, compared to 100% of utilities expressing high or medium level concern. Clearly education is needed – or an extreme climatic event -to encourage adaptation.*” If the economy is entering a period of recession it will be even harder to persuade business to start planning for the uncertain impacts of climate change.

Climate change adaptation measures are, in some ways, a measure of risk. Flood risk is an example where the risk of flooding for any area is expressed as a frequency, e.g. “1 in 100 years”. The level of adaptation measure applied should be proportionate to risk, e.g. buildings on top of a mountain are likely to have low flood risk. Many industries use established rules of thumb or return periods (the expectation of rare events informed by long time-series of observations), an example being predictions of energy demand where nearly 80 years of historical demand data for the domestic market are used to give scenario modelling of future years^{xxv}. Industry (and others) will need to re-calibrate or to re-design the decisions made on historical information on the basis of our evolving climate; the past no longer represents the future.

Similarly, longer term economic impacts will need to inform future decisions about repairing and renewing assets after flood or storm damage: should these decisions take account of the same thing happening again, or happening more frequently in the future? If we only repair to the same standard as before, and do not build in climate change adaptation measures, e.g. making a building or infrastructure more resilient to flooding, the recovery cost may be a poor investment.

The most successful adaptation measures will be those which also give mitigation benefits (the ‘win-win’ solutions) such as removing surface water from foul sewerage systems or improved water efficiency that reduce the volume of water that needs to be pumped and thus save energy.

The main market tool for delivering adaptation is insurance which has a long history of driving risk management through pricing risk, providing incentives to reduce risk, and imposing risk-related terms on policies. By accurately measuring and pricing today's climate risks, insurance can help incentivise the first steps towards adaptation by reducing premiums where adaptation has been made. The extra cost of insurance could act as a disincentive to build on high flood risk areas. Market signals of this kind encourage individuals or firms to reduce their present-day risk to weather damage because of the cost saving associated with taking steps to manage climate risks. Considering the future climate impact trends, adaptation is the key to maintaining insurance products that are affordable and available. However for rapidly escalating costs, even insurance capacity may not be sufficient to cover the costs^{xxvi}.

According to the Stern Report, effective adaptation of long-term investments is unlikely to occur through market dynamics alone when there is limited incentive to invest today to avoid future losses for the next generation. Decisions that leave a long-lasting legacy for future generations require private agents to weigh the uncertain future benefits of adaptation against its more certain current cost. For example, given the uncertainty and imperfections in property markets, the investor may lack confidence that extra resilience will be fully reflected in resale value in future.

Individuals and firms will require sufficient information to build long-term horizons and make adaptation decisions that fully reflect the risks and net benefits over the lifetime of the decision. In terms of economic priorities, infrastructure should be an important focus of adaptation efforts, because decisions taken today leave a long legacy for future generations when the impacts of climate change will be felt most sharply.

The Stern report therefore advises that some market intervention may be required in order to promote the proper pricing of risks of climate change in long-term investment decisions. It notes that regulatory measures are often less efficient and flexible than market mechanisms, but may have an important role to play in avoiding unanticipated early obsolescence of capital stock. Policies will be more efficient if they encourage private individuals and firms to take explicit account of the economic costs of climate change in their decision-making, rather than simply imposing prescriptive design standards. Stern suggests that a developer will make a rational decision about whether to increase the long-term resilience of infrastructure or to design buildings with shorter lifespan if required to consider the impacts of climate change over the lifetime of the property.

All this seems to suggest that most industry has yet seriously to consider, let alone invest in, adaptation, and we have seen nothing to suggest that Welsh business is any different to their counterparts elsewhere.

In addition, it is generally accepted that the market cannot be expected to provide assets for the public good, e.g. major new flood defences, or the research projects needed to improve understanding of the likely impacts of climate change.

SECTION 5 - QUESTIONS ARISING FROM THESE ISSUES

The timescale of climate change impacts, as compared to business planning cycles and immediate market pressures, may make it difficult for business to justify expenditure on taking adaptation measures. How can Welsh industry be encouraged to factor climate change adaptation into its future planning?

If market forces (such as the need of businesses to ensure the continuity of supplies) cannot be relied upon to deliver adequate adaptation, is more Government intervention needed? If so, what form should that take?

What can be done to explore and to improve understanding of the relative costs and benefits of adaptation compared to mitigation?

Communication has to be in a manner that is appropriate to the audience, which is everyone. This means that we need a communication strategy that speaks to all in appropriate language and gives clear messages for both citizens and economic sectors. For individuals and organisations to be able to prepare for climate change they need a context in which they are able to imagine their future activities. Words and high-level concepts work for some, but for many a picture of how the world may look to the next generation will be a more effective motivator of change.

At the moment we express climate change in terms of risk, e.g. 1:100 year flood risk, but present very little information on the extent or size of impact. To facilitate an adaptive and innovative response to climate change, perhaps communication of the impacts should move past the language of risk and into that of practicality, e.g. should we try saying “there is a 1% chance every year of this street being under 6 feet of water” instead of “an area has 1 in 100 flood risk”? How can we best persuade our audience of the importance of climate change adaptation?

The following section includes some suggestions as to how Wales might move forward on some of these questions.

SECTION 6 - HOW TO ENCOURAGE THE WELSH ECONOMY TO BEGIN ADAPTATION

There will need to be a concerted effort by the public and private sectors if adaptation is to be mainstreamed into the economy of Wales. Given the breadth of its functions and close working relationships with all major public and private institutions, the **Welsh Assembly Government** is uniquely placed to assume a leadership role for the delivery of climate change adaptation in Wales.

To that end, its decision to establish a Cabinet Committee on Climate Change chaired by the Minister for Environment, Sustainability and Housing and whose membership includes the Minister for the Economy and Transport is welcome^{xxvii} as is the establishment of the Climate Change Commission for Wales which brings together members from all four political parties, businesses, local government and voluntary sector groups.

Recommendation 1. Left to their own devices, market forces are unlikely to deliver the full response required to deal with the challenge of climate change. The Welsh Assembly Government must assume a leadership role in the delivery of climate change adaptation in Wales.

The Welsh Assembly Government should seek to deliver an adaptation policy that provides reasonable protection against risk in the future, but which is affordable for industry and the wider economy of Wales, so does not put Wales at a competitive disadvantage, or create further hardship for the poorer sections of the Welsh community.

We assume that it is unlikely that the Welsh Assembly Government will obtain significant new resources to dedicate to climate change adaptation. However, it already has a number of levers,

including financial ones, through which it could incentivise and so help to deliver climate change adaptation.

According to its “*One Wales*” document^{xxviii}, the Welsh Assembly Government’s “*vision is of a Wales where there is a strong and enterprising economy and full employment based on quality jobs*”. The document also places emphasis on Wales playing the fullest possible part in reducing its CO2 emissions. In strategic documents such as “*One Wales*” the Welsh Assembly Government needs to include a similar commitment to preparing Wales for the impacts of climate change. The emphasis on both mitigation and adaptation in the latest update of the Welsh Assembly Government’s Spatial Plan^{xxix} is welcome and hopefully the remade sustainable development scheme^{xxx} will also embrace this message.

The Welsh Assembly Government and the public bodies it sponsors should become exemplars of good practice. Thus, for example, the Welsh Assembly Government should avoid locating motorways in flood plains: such roads will be vulnerable themselves and will tend to attract development, including industry, into their corridors. Support for new rail links should be conditional upon service providers factoring adaptation into their plans. Similarly, the Welsh Assembly Government should seek to ensure that in future key facilities such as hospitals are not in vulnerable areas and that health services are preparing for the health impacts of climate change referred to above. The Welsh Assembly Government and its sponsored public bodies should send a clear signal to those procuring business from them of the high priority they attach to adaptation measures.

Recommendation 2. Affordable, appropriate and reasonably robust climate change adaptation measures must be mainstreamed into Welsh Assembly Government strategic policy documents and resulting policies and measures, including its procurement policy. Its sponsored bodies should follow its lead.

The Welsh Assembly Government represents Wales in its dealings with UK Government and other government bodies and external agencies. The Welsh Assembly Government should work closely with its counterparts in Whitehall to ensure that UK climate change adaptation policy is appropriate for Wales and the Welsh economy and should encourage the development of innovative policy responses to the climate change threat. As part of this, the Assembly Government should encourage Whitehall to consider fiscal measures to encourage adaptation.

The Welsh Assembly Government has a major role in civil contingency emergency planning: this is another key element in enabling the economy to recover from short term incidents resulting from climate change, for example in minimising disruption to the vital infrastructure on which the economy relies.

Recommendation 3. The Welsh Assembly Government should liaise closely with Whitehall and other agencies regarding UK climate change adaptation, including resilience planning. In particular, the Assembly Government should encourage the Treasury to consider fiscal measures, such as tax relief on adaptation measures.

The current uncertainties hamper business planning and make widespread adaptation by industry unlikely. Further research is needed into the impacts of climate change on the Welsh economy as well as the natural environment but it is unlikely to be carried out unless funded by the public purse. The Welsh Assembly Government should continue to attach priority to understanding what, when and

where the impacts of climate change will be felt in Wales, and into the relative costs and benefits of adaptation compared to mitigation. As suggested by the Met Office^{xxxii}, such research might include seeking to quantify the actual benefits from adaptation measures compared to the (non-adapted) disruption and post event clean up.

The more robust the available information, the easier it should be to persuade relevant organisations to invest in adaptation. However, such research should not be used to justify procrastination in terms of providing urgent adaptation measures.

Recommendation 4. The Welsh Assembly Government and its partners should continue research to improve the understanding of the costs and wider impacts of climate change on the Welsh economy.

Based on the better understanding of potential climatic impacts across Wales and locally that UKCIP08 will provide, there is a need for a vulnerability assessment to focus adaptation activity and ensure that it addresses the relevant threats. The Welsh Assembly Government and its partners should give priority to distributing a readily understood version of UKCIP08 and other useful information about the projected impacts of climate change to relevant organisations in Wales (e.g. trade associations; the construction industry). Tools like the UKCIP ‘adaptation wizard’ should be promoted to Welsh business through training and education.

Recommendation 5. The Welsh Assembly Government and its partners should disseminate a readily understood version of UKCIP08 and other useful information to relevant organisations in Wales and should promote tools like the ‘adaptation wizard’ to Welsh business.

The Welsh Assembly Government has considerable influence over industry in Wales. Its Economy and Transport Department provides grant aid to industry plus other forms of advice and support, e.g. helping companies to find suitable premises. The Assembly Government should take appropriate opportunities to educate Welsh companies about climate change issues and encourage them to consider mitigation (which can reduce their energy bills significantly) and adaptation measures (such as reducing water use, which will also reduce their water bills).

Companies should also be advised that there is an advantage to them in developing business strategies that are resilient and adaptive in the face of climate change impacts, e.g. making sure that stock is protected from extreme weather events.

Adaptation to climate change presents an opportunity for Wales as a knowledge based economy with a strong environmental goods and services sector. There is scope for innovation in providing adaptation measures, e.g. technologies for flood protection or water efficiency. The Welsh Assembly Government could seek to identify market opportunities and encourage Welsh industry to exploit them. It is therefore welcome that research is already proposed to identify opportunities and support for the development of innovative goods and services through the convergence program and other support mechanisms.

The Welsh Assembly Government’s “One Wales”^{xxxiii} document included a commitment to developing an “All Wales Green Jobs Strategy” to promote the greening of businesses and so meet the twin goals of enhanced competitiveness and contributing to the Welsh Assembly’s environmental targets, particularly for climate change. The Strategy will provide a vehicle to persuade industry in Wales of the commercial advantages of adopting sustainable business practices.

Recommendation 6. The Welsh Assembly Government should use its influence to persuade Welsh business of the business case for climate resilience, assist business with the development of sustainable, resilient strategies and support industry in seeking innovative business opportunities arising from adaptation. Its “All Wales Green Jobs Strategy” should enable the Welsh Assembly to formulate and promote its policy in this area.

Through its information services and financial support schemes, the Welsh Assembly Government has close links with agriculture in Wales. As recommended in “*Sustainable Farming and Environment: Action Towards 2020*”^{xxxiii} the Welsh Assembly Government should encourage agriculture to begin responding to the threats posed by climate change and it should use its financial assistance in this way. For example, farmers could be compensated for enabling their farmland to hold water during potential flooding events to protect urban areas during periods of heavy rain. Incentives could also be provided to encourage farmers to capture and store water during periods of heavier rainfall to reduce their need to abstract during drier periods. If supported by grant aid, agriculture could play an important role in the provision of environmental corridors to enable threatened species to migrate if their existing habitats are affected by climate change.

Recommendation 7. The Welsh Assembly Government should encourage agriculture in Wales to plan for the impacts of climate change. Assuming it would be permissible under European rules, the Welsh Assembly Government should consider using its financial assistance to encourage agriculture to take measures that will contribute to adaptation.

The Welsh Assembly Government has previously announced that it is discussing with the UK Government the devolution of the Building Regulations to allow it to set out a standard framework, including zero carbon, for all buildings^{xxxiv}. Through amendments to the Building Regulations the Assembly Government could ensure that relevant adaptation provisions are considered for incorporation in new build, such as improved standards relating to subsidence and suitable, sustainable drainage. The delivery of such changes through the Building Regulations would ensure a level playing field for the construction industry in Wales and overcome the short-termism referred to above, although such additional regulation may represent unwelcome additional “red tape”.

Through its Planning Guidance and associated Technical Advice Notes (TANs), the Welsh Assembly Government sets the framework for development planning in Wales. TAN 15 on Development and Flood Risk gives prominence to climate change implications. The Assembly Government has also recently undertaken a consultation exercise on proposed further amendments to Planning Policy Wales relating to the design of developments to include climate change mitigation and adaptation measures and the use of sustainable building standards in Wales^{xxxv}. The Welsh Assembly Government should continue to lead policy in this direction.

Recommendation 8. The Welsh Assembly Government should continue to use its development planning functions to encourage the delivery of climate change adaptation. If and when the Building Regulations are devolved, they will also provide a useful tool for this.

Local government will have an important role in helping Wales to adapt. In particular, local authorities will be able to exercise their development control functions to ensure that developments are generally steered away from those areas most vulnerable to flooding or suffering particular problems relating to water and sewerage infrastructure. It is unlikely that conventional drainage will

be able to cope with levels of rainfall predicted for the future: local planning authorities will be able to encourage the provision of sustainable drainage systems which are likely to be an important part of the UK's adaptation response. Section 106^{xxxvi} agreements/ planning gain may help to deliver adaptation measures such as environmental corridors for threatened species. Local authorities also have powers to undertake flood defence works.

Recommendation 9. In line with guidance from the Welsh Assembly Government, unitary authorities in Wales should use their functions to encourage the delivery of climate change adaptation.

The financial regulators of the power, telecommunications and water industries will have considerable influence over whether the providers of these major infrastructures and essential services commence adaptation. For example, the water industry regulator, Ofwat^{xxxvii}, is encouraging the industry to produce strategic direction statements looking ahead 25 years and has indicated that it expects water companies to plan for climate change adaptation as part of the water price setting round for 2010-2015. The regulators should consider climate resilience an integral part of their regulation duty. There may need to be an assessment of whether these regulators have sufficient powers to require regulated companies to ensure that their systems are sufficiently resilient: where necessary their statutory remit may have to be changed.

Recommendation 10. Given the economic importance of modern infrastructure, the financial regulators of the power, telecommunications and water industries must ensure that their industries commence appropriate climate change adaptation measures and have sufficient funding to do so.

Through their statutory duties and powers, the Environment Agency and Countryside Council for Wales will be at the forefront of seeking to help the natural environment in Wales to adapt to the impact of climate change. For example, in order to increase the resilience of the water environment and to ensure compliance with European Directives, the statutory regulators may judge that abstractions should be reduced (to protect flows) or the quality of effluent discharges should be improved (as lower flows will reduce the available dilution). Particularly given the uncertainties surrounding the impacts of climate change, the regulators may encounter resistance from industry. In exercising these functions, the regulators should work with those they regulate, e.g. in agreeing land management plans with farmers, and should seek a consensus about the best way forward. They need to take account of the affordability of such measures for industry and their customers.

Looking forward, environmental standards may themselves need to become adaptive and future proofed, i.e. they should be set in a way that recognises the impacts of climate change and allows the natural environment to change in response, rather than imposing ever tighter standards in an attempt to protect the current "natural" environment from climate change. To deliver this capability, the conservation agencies will need to invest in learning more about the environment we seek to preserve and protect, for example learning more about the ecological needs of particular species, so that environmental standards can be set with confidence rather than over-precaution. Industry is likely to be more sympathetic to tighter standards if they are founded on sound science. We welcome the efforts the statutory regulators are already making to improve our understanding of the impacts of climate change which should strengthen the scientific basis of their work.

The Environment Agency has a leading role in terms of flood risk management in Wales. In deciding what to protect, the economic value of the land (including the infrastructure on it) will need to be taken into account.

Recommendation 11. In adapting to the impact of climate change, the Environment Agency and Countryside Council for Wales should continue to exercise their statutory duties to protect the natural environment, in a way that meets statutory obligations, is scientifically robust and does not impose excessive costs (in relation to benefits gained) on regulated organisations or on society more widely..

Major trade associations and professional bodies, e.g. the Confederation of British Industry, Home Builders Federation, Royal Town Planning Institute, the Landscape Institute (who are all represented on the economics sub-group) and the farming unions will have an important role in spreading the adaptation message and promoting examples of best practice to their members.

Recommendation 12. Major trade associations, the farming unions, professional bodies etc should spread the adaptation message to their members and point them in the direction of further advice and support and disseminate examples of best practice.

We should try to ensure that the public knows about climate risks now and in the future. Risk information will enable people to take informed decisions about investment in resilience measures and become involved in the implementation of adaptation policy measures. Customers exercise considerable influence over industry and can force them to change their practices. Individuals should use their spending power to encourage adaptive change by the Welsh economy (e.g. by checking that properties are built to adaptive design standards).

Recommendation 13. Greater efforts should be made to inform the public about climate risks. Individuals should use their spending power to encourage adaptation by business.

It is not the role of the Adaptation Sub Group to assess the role of economic growth in the causes of climate change but in the Sub Group's discussions this was highlighted as an area requiring interrogation by the Commission.

Recommendation 14. The relationship between current economic models and climate change – in terms of mitigation and adaptation - requires critical evaluation by the Climate Change Commission.

References

- ⁱ Intergovernmental Panel on Climate Change confirms that less developed countries are most vulnerable
- ⁱⁱ See the UK Climate Impacts Programme's (UKCIP) regional studies
- ⁱⁱⁱ "One Wales – A Progressive Agenda for the Government of Wales", June 2007
- ^{iv} Department of Energy and Climate Change announcement of 16 October 2008
- ^v European Commission press release of 29 June 2007
- ^{vi} COM(2007) 354. "Adapting to climate change in Europe – options for EU action". Green Paper from the Commission to the Council, the European Parliament, the European Economic and Social Committee and the Committee of the Regions, June 2007
- ^{vii} Climate change: the cost of inaction and the cost of adaptation (EEA Technical report No 13/2007)
- ^{viii} Climate Change Adaptation for UK Businesses, Met Office, July 2007
- ^{ix} Under the Water Resources Act 1991
- ^x According to the Stern Report, the Association of British Insurers (2004) estimates that subsidence costs to buildings could double by the middle of the century to £600 million (2004 prices)
- ^{xi} Climate Change Adaptation for UK Businesses, Met Office, July 2007
- ^{xii} Stott, P.A., Stone, D.A. and Allen, M.R., 2004: Human contribution to the European heat wave of 2003. *Nature*
- ^{xiii} McGuire, B, 2004: Climate Change 2004, Benfield Hazard Research Centre, Technical Paper 02, University College London, 2004.
- ^{xiv} The Pitt Review Interim Report
- ^{xv} Climate Change Adaptation for UK Businesses, Met Office, July 2007
- ^{xvi} Stern, N. (2007) *The Economics of Climate Change*, Cabinet Office -HM Treasury; Cambridge; including supporting material and papers that were presented at a Stern Review Workshop on the "Economics of Adaptation" on 9 May 2006
- ^{xvii} Llewellyn, J, 2007: *The Business of Climate Change –Challenges and Opportunities*, Lehman Brothers, February 2007
- ^{xviii} "Valuing the Environment of Wales A Review 2001–2006" see http://www.nationaltrust.org.uk/main/w-wales-valuing_our_environment-review-english.pdf
- ^{xix} "Wildlife Economy Wales: An Economic Evaluation Scoping Study, 2007" commissioned by the Environment Agency Wales, with the support of Welsh Assembly Government, Countryside Council for Wales and Forestry Commission Wales .see <http://www.ccw.gov.uk/publications--research/research--reports/wildlife-economy-wales-an-e.aspx>
- ^{xx} Study into Inland and Sea Fisheries in Wales (Nautilus Consultants), October 2000
- ^{xxi} According to the "Go Wales" website, tourism in Wales produces revenues of around £3bn a year
- ^{xxii} Dŵr Cymru Welsh Water, November 2007
- ^{xxiii} "Raw" water is water abstracted prior to treatment
- ^{xxiv} Climate Change Adaptation for UK Businesses, Met Office, July 2007
- ^{xxv} Met Office report referring to National Grid winter outlook 2006/2007. See www.nationalgrid.com/uk/Gas/TYS/outlook
- ^{xxvi} Stern report Part V
- ^{xxvii} Cabinet Statement of 8 April 2008 by Minister for Environment, Sustainability and Housing
- ^{xxviii} "One Wales – A Progressive Agenda for the Government of Wales", June 2007
- ^{xxix} "People, Places, Futures - The Wales Spatial Plan – 2008 Update" approved by National Assembly for Wales July 2008
- ^{xxx} On 22 May the Minister announced her decision to remake the Sustainable Development Scheme
- ^{xxxi} Climate Change Adaptation for UK Businesses, Met Office, July 2007
- ^{xxxii} "One Wales – A Progressive Agenda for the Government of Wales", June 2007
- ^{xxxiii} Report to the Welsh Assembly Government, published in 2007
- ^{xxxiv} Welsh Assembly Government press notice, 13 February 2007
- ^{xxxv} Welsh Assembly Government "Further Consultation on Planning for Climate Change", July 2008
- ^{xxxvi} section 106 of the Town and Country Planning Act 1990
- ^{xxxvii} The Water Services Regulation Authority