

CUTTING CARBON: **CREATING JOBS**

REPORT BY
STOP CLIMATE CHAOS CYMRU

RESEARCH BY
THE WELSH economy RESEARCH UNIT,
CARDIFF BUSINESS SCHOOL

MARCH 2011





Stop Climate Chaos Cymru (SCCC) was launched in 2005 as a coalition of groups from across civil society committed to taking combined action in Wales to combat climate change. The SCC coalition represents over 11 million people across the UK - one in every six of the population - from organisations in the environmental and development movements, as well as unions, faith groups, women's organisations and other representatives of civic society.

SCCC MEMBER ORGANISATIONS

National Federation of Women's Institutes Wales
National Union of Students
Unison
Christian Aid Wales
CAFOD
Oxfam Cymru
Tearfund
Coed Cadw – The Woodland Trust
Friends of the Earth Cymru
RSPB Cymru
Sustrans Cymru
WWF Cymru
Wildlife Trusts Wales
The Centre for Alternative Technology

This report is being disseminated with the generous support of **The Cooperative Membership**

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Published by **Stop Climate Chaos Cymru**
c/o Oxfam Cymru, Market Buildings, 5-7 St Mary Street, Cardiff, CF10 1AT

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CONTENTS

Foreword	4
Introduction	5
The SCCC contribution	7
The research	7
Economic and policy context	8
The policy proposals	9

1. ROAD TRANSPORT SHIFT TO SMARTER CHOICES

Summary	9
Policy benefits	9
Economic and carbon potential	12

2. NATIONWIDE HOME ENERGY REFURBISHMENT

Summary	13
Policy benefits	13
The Green Deal for Wales	15
Economic and emissions benefits	16

3. GREEN TECHNOLOGY SKILLS TRAINING

Summary	18
Policy benefits	19

Appendix A - Smarter Choices Wales: Economic and Carbon Potential	22
Appendix B - The Welsh Refurb: Economic and Carbon Potential	28
Appendix C - The Benefits of Green Skills to Wales	34

FOREWORD

Taking action to tackle climate change can create jobs, promote social justice and make Welsh society more resilient in the face of inevitable energy price increases.

This report by Stop Climate Chaos Cymru demonstrates three ways to make this happen.

The report does not seek to be a full climate change action plan for the new Welsh Assembly Government. We have sought to move beyond a shopping list of policies and produce a useful piece of research demonstrating how three important policy areas could be approached. For each, we have attempted a robust analysis of the costs and implications: environmental, social and economic.

We are very grateful to Simon McWhirter of the The Message Hub for facilitating the policy formulation process and drafting the recommendations. The research and evaluation work was conducted by Dr Calvin Jones and colleagues in the Welsh Economy Research Unit at Cardiff Business School. Significant parts of the report were written or edited by Peter Jones of RSPB Cymru, Alun James of WWF Cymru and Lila Haines of Oxfam Cymru.

Thanks also to Oxfam Cymru and WWF Cymru for funding the research and to The Co-operative Membership Wales for funding the dissemination of the findings.

Julian Rosser
Chair - Stop Climate Chaos Cymru

INTRODUCTION

The Assembly Government has identified climate change as ‘the greatest threat facing humanity’, to which should be added impacts upon wildlife and the broader natural environment, on which we depend for such basic necessities as cultivable soil, fresh water, the growing of food and predictable seasons.

Stop Climate Chaos Cymru, therefore, welcomes the Welsh Assembly Government’s publication in October 2010 of a Climate Change Strategy and Delivery Plans, and notes that they enjoy the support of all political parties represented in the National Assembly. However, we also agree with the Climate Change Commission – in their Foreword to the document - that the Strategy and Plans are only a ‘starting point from which to build’, and that much more will be needed from government and all sectors of Welsh society if we are to limit the global temperature rise above pre-industrial levels to no more than 2C.

The Assembly Government adopted an annual greenhouse gas emission reduction target from 2011 of 3% in its One Wales policy agreement (June 2007) and, more recently, the National Assembly has agreed a reduction target of 40% from 1990 levels by 2020. These targets reflect UK, EU and global aims and objectives, not least the generally accepted reduction target for Annex I developed economies of at least 80% from 1990 by 2050. On various emission and probability assumptions, milder, wetter winters and warmer, dryer summers are projected for Wales as we progress through the 21st century¹.

We share the view of the Minister for Environment, Sustainability and Housing – in her Foreword to the Strategy – that climate science points to the need for more rapid carbon emission reductions than the Assembly Government’s 3% annual target. Various reports, including notably from the Tyndall Centre for Climate Change Research on behalf of the Commission², suggest that anything up to annual emission reductions of 9% are needed, with emissions from developed countries peaking by around 2015 and from non-developed countries by about 2020.

Moreover, it is even suggested that ‘there is now little to no chance of maintaining the global mean surface temperature [increase] at or below 2°C’³. Even worse, it is suggested that ‘2°C now more appropriately represents the threshold between “dangerous” and “extremely dangerous” climate change’⁴. The gap between science and policy is, therefore, wide and growing wider.

Consequently, it is a matter of concern that Welsh emissions from all sources in 2008, the latest year for which complete data are available, rose by nearly 6%, possibly in consequence of increased heavy industry emissions. Current capacity to constrain and reduce emissions is shown to be at risk from the vagaries of economic activity; it is very likely that the emission statistics for the post-2008 economic downturn, when available, will show significant falls in emission levels. Neither set of emission movements will have been attributable to the influence of Government climate change policy.

This concern is reinforced by the Strategy’s calculation that only about one-third of the 3% target can be delivered by the Assembly Government, with the balance to be met by a combination of EU and UK Government measures, together with independent actions by businesses and other sectors.

The success of the Strategy in meeting the Welsh targets, even within areas of devolved policy competence, is therefore contingent upon successful emission reduction measures at EU and UK government levels. This was not clear back in 2007 and is a source of disappointment. This very

1. United Kingdom Climate Projections 09; ukclimateprojections.defra.gov.uk

2. 3%, 6%, 9% Emission Reduction Scenarios for Wales; D Calverly, R Wood, S Mander, K Anderson; Tyndall Centre for Climate Change Research, November 2009.

3. Beyond ‘dangerous’ climate change: emission scenarios for a new world; K Anderson & A Bows; Philosophical Transactions of the Royal Society A, Vol 369, p20, December 2010.

4. Ibid, p20.

limited achievement begs the obvious question as to whether more could be done within the current powers and resources available to the Assembly Government.

The Government has suggested that Tyndall's proposals, even in part, would be too costly to implement. However, the Tyndall Report suggests that there is 'substantial economic benefit to be had from making the necessary changes earlier rather than later'⁵, and that early transition to a low-carbon Wales will avoid higher costs in the future as energy prices rise and the supply of fossil fuels declines in the context of rising global demand. The Report makes a number of proposals for delivery through its preferred 9% emissions reduction scenario, including in the residential and transport sectors.

SCC Cymru has taken the view that the Assembly Government can and should seek to do more than is set out in its Strategy and, as necessary, should be prepared to identify additional funding to make this possible. Too much of the Strategy would appear to have been chosen on the basis of what could be afforded within a largely historically determined budget rather than starting from a funding position sufficient to afford what actually needs to be done.

The Strategy sets out its thinking and proposals under the following sector heads:

- Transport
- Business
- Residential
- Agriculture and Land Use
- Resource and Waste
- Public

Only the target for Resource and Waste looks set to make a reasonable contribution, whilst the targets for the Business and Agriculture/Land Use sectors look modest and for the Residential and Transport sectors disappointingly low.

Clearly, therefore, more can and must be done. However, we feel that the Strategy does not deliver adequately on the seriousness of the threat, and falls short of what will prove necessary if Wales – and the wider developed world – is to achieve the scale of emission reduction that the science tells us will be needed – and soon. Clearly, more can and must be done.

5. Ibid, pp 51/52.

THE SCCC CONTRIBUTION

Stop Climate Chaos Cymru (SCCC) was launched in 2005 as a coalition of groups from across civil society committed to taking combined action in Wales to combat climate change⁶. Our mandate is simple: to take socially beneficial action to prevent global temperature rises exceeding the two degrees C threshold above which the likelihood of irreversible and devastating climate change becomes unacceptable.

SCCC and its member organisations have been instrumental in driving forward the climate agenda in Wales. Both in the Welsh context and as a part of the wider UK Stop Climate Chaos coalition (SCC) we have shifted the debate from ‘whether’ climate change is happening, and have taken both politicians and the wider Welsh public with us towards a commitment to year-on-year action to reduce carbon emissions.

KEY SCCC SUCCESSSES

Stop Climate Chaos Cymru was instrumental in gaining broad political support for the principle that year-on-year targets were required to ensure a real decrease in greenhouse gas emissions from Wales. This commitment made its way into the manifestos of several political parties fighting the 2007 Assembly elections and was then reflected in the One Wales agreement between Welsh Labour and Plaid Cymru as they formed the Assembly Government.

SCCC also campaigned for the National Assembly to adopt a strong policy stance that Wales should reduce its greenhouse gas emissions by 40% on 1990 levels by 2020. This policy was passed unanimously by the Assembly in November 2009 as hundreds of people from Wales travelled to London and Copenhagen, with an eighteen foot long blue dragon, to join demonstrations calling for a fair, ambitious and binding global deal to tackle climate change.

The questions now are: ‘how far do we need to go?’, ‘how fast?’ and ‘how do we get there?’. SCCC believes that the current policies and proposals from the Welsh Assembly Government (WAG) will deliver neither the necessary scale nor speed of change we desperately need.

THE RESEARCH

In order to help the new Assembly Government take the decisions necessary to achieve substantial progress towards its climate change targets, SCCC commissioned research by Cardiff Business School’s Welsh Economy Research Unit on three key areas capable of contributing substantially towards a reduction in Welsh greenhouse gas emissions, while simultaneously promoting social justice in Wales.

In the current economically straitened times all parties involved in climate and social policy have difficult decisions to make. In Wales, climate change is rightly seen as integral to the policy-making process, and no longer as simply a sustainability bolt-on. However, despite the recent forward-thinking nature of Welsh political action on these issues – from the commitment in One Wales, the integral nature of sustainable development thinking and the three per cent carbon reduction targets –

6. The member organisations of Stop Climate Chaos Cymru are Oxfam Cymru, Unison, National Union of Students, Friends of the Earth Cymru, RSPB Cymru, Sustrans Cymru, WWF Cymru, CAFOD, Christian Aid Wales, Coed Cadw – The Woodland Trust, Tearfund, National Federation of Women’s Institutes Wales, the Wildlife Trusts Wales and the Centre for Alternative Technology.

sustained bravery in the face of this adversity is crucial. Crucial in setting the right manifesto pledges and crucial in standing by those pledges whether from within or outside government after the election.

A new Assembly Government will face a tough challenge assessing its priorities across all sectors. SCCC understands the need for prioritisation between competing needs. Therefore SCCC has conducted a similar process to agree our organisational priorities consistent with those that are vital to building a strong and resilient Wales.

We have identified those climate policies or areas most urgently requiring action; which are most necessary for consideration in relation to the 2011 Assembly elections; which fall within Welsh devolved competence; which can have a cross-sectoral impact, and can take the widest section of Welsh society on the journey to a lower carbon future.

Akin to the inter-departmental government process, SCCC has rationalised its members' multiple overlapping priorities. We want to bring clarity to the work done by the climate movement in Wales and set out those actions without which we feel Wales cannot move forward towards securing the necessary carbon reductions, and the level of localised job creation, relief from fuel poverty and improvements to health and wellbeing that these policies will also engender. While this process has focussed on SCCC's core purpose - to campaign for an absolute reduction in the levels of atmospheric greenhouse gases - we have also indicated where strong opportunities exist to deliver on wider social justice and sustainable development objectives.

The recommended policies fit within a wider strategic approach to delivering a low carbon Wales, while reducing absolute emissions over a ten year period in line with the science.

SCCC, in conjunction with the Welsh Economy Research Unit at Cardiff Business School, has analysed the wider deliverability and costs associated with these recommendations. Details of this research are contained in the appendices. A strategic, linked approach to implementing these policy proposals is essential, whether we are considering necessary infrastructure improvements alongside car reduction initiatives, or how to employ an area-based approach to home energy refurbishment. Without this, the delivery of carbon reduction policies becomes unpredictable at best, non-existent at worst. This at a time when carbon abatement is vital, and must be predictable.

ECONOMIC AND POLICY CONTEXT

Policy-making rarely occurs in a vacuum free from real world financial and social pressures. Moreover, the current framing for these decisions finds us in the most challenging economic times in the UK for decades. Therefore, what is essential and has been recognised in the formulations used in this report, is that we must focus on, and deal with, the economic landscape that we have, not that which we wish we had. All the recommendations made in this report are designed to suitably meld with the times we find ourselves in. In essence, we have performed a financial reality check to help frame these difficult decisions that must be made.

It remains to be seen whether WAG will seriously mainstream a commitment to sustainable development as the central organising principle of the Welsh Assembly Government as previously encompassed in One Wales: One Planet. While WAG's economic renewal strategy⁷ and the Wales Spatial Plan⁸, among others, contain some crucial elements for the planning and delivering of a sustainable Wales, it is far from the requisite crosscutting analysis of what is happening and what needs to happen for a robust forward-looking nation. What is of real concern, and has been addressed in detail in the policy analysis in this report, is that the current green jobs strategy – Capturing the Potential⁹ - has not been incorporated into these growth and spatial plans.

7. Economic renewal: a new direction <http://wales.gov.uk/docs/det/report/100705anewdirectionen.pdf>

8. People, Places, Futures <http://wales.gov.uk/about/programmeformgovernment/strategy/spatial/?lang=en>

9. <http://wales.gov.uk/docs/det/publications/090709capturingthepotentialagreenjobsstrategyforwalesen.pdf>

THE POLICY PROPOSALS

The key policy recommendations from SCCC for a coordinated programme of climate action in Wales are:

1. A shift from personal road transport to a system of 'Smarter Choices'
2. A nationwide programme of home energy refurbishment
3. A programme of investment in skills training for the implementation of green technology

Details of the policy recommendations are set out below.

1. ROAD TRANSPORT SHIFT TO SMARTER CHOICES

SUMMARY

As part of a wider shift from road building to more sustainable transport options, we must facilitate a move towards the adoption of Smarter Travel Choices.¹⁰ Functioning as part of a wider, integrated travel strategy, Smarter Choices encourages lower impact travel alternatives to the car, such as: better transport planning for getting to school or work; better information about current public transport services; innovative business solutions such as videoconferencing to reduce the most unsustainable long distance travel; increased walking and cycling and better use of the internet to minimise unnecessary travel. At a cost of just £10 per person¹¹, this mobility behaviour change policy could be implemented across Wales at a cost of just £30 million, delivering carbon reductions (quantified below) at extremely low cost¹².

Ostensibly geared at changing travel behaviour, the shift to Smarter Choices, which have proven popular with residents engaged in the pilot programmes, should be seen as a pathfinder policy with the potential to promote carbon reductions in other areas of people's lives.

POLICY BENEFITS

Smarter Choices encompasses a range of alternative personal transport modes focussed on cutting car traffic and avoiding the need to construct new carbon-intensive 'hard' transport infrastructure. These 'soft' measures largely involve the promotion of, and concurrent education about, existing alternatives to the car, which currently accounts for almost 70% of all journeys made in Wales¹³. However, targeted complementary infrastructure, such as cycle lanes, can enhance and help 'lock in' the benefits afforded by the programme.

Smarter Choices include:

- Improving the quality and marketing of information in relation to sustainable personal transport options
- Improving public and other non-vehicular transport services, and related advice services, in a targeted fashion
- Developing local facilities and technology that help reduce the need to travel

¹⁰ See <http://www.dft.gov.uk/pgr/sustainable/smarterchoices/>

¹¹ This is the cost per head obtained for the rollout of the same programme in England – English Sustainable Transport Towns.

¹² <http://www.scotland.gov.uk/Topics/Transport/sustainable-transport/Places>

¹³ Smarter Choices: Wales - <http://wales.gov.uk/docs/det/publications/070215smarterchoicesen.pdf>

This programme has been rolled out across various English cities and the impacts across a range of areas beyond the environmental, such as health, wellbeing and improved local business efficiency through reduced congestion, have been exemplary. Further, and of real importance, is the fact that this policy encapsulates the sort of behavioural shift that we need from high to low carbon choices. Across all sectors, we will need to tackle public intransigence to more sustainable lifestyle choices. This shift has been achieved on a widespread national basis in relation to kerbside and collection centre waste recycling, and switching one car journey a week to a Smarter Choice is a similar habit change. A shift to Smarter Choices in our personal transport could be the next step in helping to build a framework for people to better comprehend and be more accepting of wider systems change in their own lives.

The evidence base for the Smarter Choices move, which comes from the rollout of the programme to several English cities, has established that the barriers to changing public behaviour in this area are about false perceptions – e.g. that it may double journey times to use public transport – and from a lack of information – e.g. that people are often unaware of the alternative transport options available to them in their locale.

The use of Smarter Travel Choices, which can be initiated using existing facilities, has gained high level support, as well as widespread backing from Welsh stakeholders including the Sustainable Transport Cymru alliance.

The Smarter Choices proposal falls within the Assembly Government’s remit, and in 2007 they published a guide recommending 19 Smarter Choices options to influence travel behaviour, and SCCC advocates that they should be introduced across the regions of Wales as a matter of priority, with initial rollout across urban and suburban centres.

Travel Planning	Residential Travel Plans School Travel Plans Workplace Travel Plans Personalised Travel Planning
Public Transport	Bus Rail Taxi Park and ride
Healthy Options	Walking and cycling Health
Smarter Cars	Car Clubs Car Sharing
Technology and Marketing	Teleworking and Teleconferencing Public Transport Information and Marketing Travel Awareness Campaigns
Tourism and Special Events	Tourism Special Events
Freight and Home Shopping	Sustainable Freight Home shopping and local produce

14 The Committee on Climate Change recommended a wider roll out of Smarter Travel Choices in its October 2009 report. Committee on Climate Change, 'Meeting Carbon Budgets' Oct09, p227 <http://downloads.theccc.org.uk/docs/21667%20CCC%20Report%20Chapter%206%20to%20the%20end.pdf> In January 2010, Chief Executive David Kennedy said: "The Government should implement a phased national roll out of Smarter Travel Choices schemes across the UK" The King Report to the Treasury on Low Carbon Cars recommended that "all local authorities should ensure that smarter choices are a priority in their local transport strategy" Pages 75-79 http://webarchive.nationalarchives.gov.uk/+http://www.hm-treasury.gov.uk/d/bud08_king_1080.pdf

CASE STUDY

An integrated Smarter Choices package was rolled out over the very successful five year English Sustainable Travel Town (STT) programme¹⁵ that delivered key evidence of population-wide changes in people's travel behaviour. These included:

- Reductions in car-as-driver trips of between 7 and 9%;
- Increases in walking trips of up to 14%;
- Increases in cycling trips of up to 113%;
- Increases in bus use of up to 35%; and
- Increases in time spent travelling by active modes (walking and cycling) of up to 16% (or an additional 16 hours per person per year).

Across the three English towns – Darlington, Peterborough and Worcester – this programme resulted in a total of 84 million km of car travel being taken off the roads each year, equating to estimated annual savings of more than 17,000 tonnes of carbon dioxide.

The Smarter Choices proposal is within the Assembly's competence and in keeping with WAG's National Transport Plan¹⁶.

Despite the significant shift in personal travel behaviour that the STT programme achieved, day-to-day mobility (in terms of trips made per person per day) remained constant, demonstrating that Smarter Choices didn't prevent or restrict people from travelling. This is an important consideration to bear in mind when designing the public engagement aspects of the programme rollout.

This policy delivers carbon reductions, and the wider policy boons it affords, at very low cost. Demonstrating real value for money, it cost just 4p per car km removed in the English Sustainable Travel Towns. This delivers a Benefit Cost Ratio of 4.5 for congestion alone that would likely be doubled if health, consumer benefit and environmental benefits were also taken into account.¹⁷ Recent research for the Scottish Government suggests that sustainable transport initiatives are among the most cost-effective measures for reducing climate impacts, with an indicative cost for some measures of just £10 per tonne of CO₂ abated over the period¹⁸.

Smarter Choices deliver efficiency gains first as they maximise the utility of facilities, infrastructure and services already in place. Through their promotion of public transport use they engender greater accessibility, and enhance social inclusivity¹⁹ as well as delivering these immediate and cheap carbon reductions. By shifting spending away from measures that reinforce car dependency Smarter Choices will help to create a more socially just Wales.

Smarter Choices programmes also provide direct boosts to health and wellbeing, as well as improving business competitiveness through combating road congestion.

- **Health benefits:** Reduced vehicular transport leads to improved air quality, and the increase in walking and cycling fosters direct public health benefits. In the Peterborough trial, there was an increase of 18 per cent of daily time spent in physically active forms of travel.²⁰

15 http://www.google.co.uk/url?sa=t&source=web&cd=3&sqi=2&ved=0CCwQFjAC&url=http%3A%2F%2Fwww.sustrans.org.uk%2Fassets%2Ffiles%2Ftravelsmart%2FTravel_Behaviour_research_in_the_STTs_briefing_note_June_2009.pdf&rct=j&q=english%20sustainable%20travel%20town&ei=vNyaTPuNNdm5jAe7joGDCg&usq=AFQjCNGvxQV9VW7v2ZCVb4PRrb4kINrQeQ&cad=rja

16 <http://wales.gov.uk/docs/det/consultation/090715nationaltransportplanen.pdf>

17 See page 8: <http://www.dft.gov.uk/pgr/sustainable/smarterchoices/smarterchoiceprogrammes/pdf/summaryreport.pdf>

18 <http://www.scotland.gov.uk/Resource/Doc/282791/0085548.pdf> - p46, as compared to reductions in bus fares or investment in rail which will cost over £3,000 per tonne of CO₂ abated.

19 25%, or over 300,000 Welsh households do not have a car – rising to some 36% in Merthyr and Blaenau Gwent.

20 Sustrans, 'Leading the way in travel behavior change' http://www.sustrans.org.uk/assets/files/travelsmart/behaviour_change_ff36.pdf
The National Institute for Health and Clinical Excellence Public Health guidance on the prevention of cardiovascular disease: "(Local Authorities Should) Apportion part of the local transport plan (LTP) block allocation to promote walking, cycling and other forms of travel that involve physical activity. The proportion allocated should be in line with growth targets for the use of these modes of transport"
Page 30 <http://www.nice.org.uk/nicemedia/live/13024/49273/49273.pdf>

- **Better quality of life:** Quieter roads make for more pleasant neighbourhoods. Home working, tele- and videoconferencing reduce work travel time and increase personal time. Residents on busy streets have less than one quarter the number of local friends compared to those living on quieter streets.²¹
- **Good for business:** Smarter Travel Choices help clear roads of unnecessary car trips. This is good for businesses, which lose £20 billion a year in the UK due to congestion.²²
- **Good for the less well off and for Rural Wales:** increased public transport patronage will protect vital services across Wales, both directly, and as cross-subsidisation between profitable and non-profitable routes becomes ever more viable.

Perhaps more importantly, as a stage on the way to the much sought after behaviour shift, people have been shown to like the Smarter Travel Choices programmes²³. Issues such as traffic growth are of direct concern to most people and they are supportive of attempts to mobilise public transport, walking and cycling options above car travel²⁴. Smarter Travel Choices empowers people to overcome a lack of information about alternatives to car travel and motivates them to try them out, overcoming key barriers to change.²⁵

ECONOMIC AND CARBON POTENTIAL²⁶

Work undertaken by the Welsh Economy Research Unit (WERU) has sought to quantify the impact of a successful Smarter Choices programme on both the economy of Wales, and on the levels of climate emissions arising in the region. WERU's long established and well regarded expertise in economic and environmental modeling enable us to get a good handle on the potential size of the benefits of smarter choices, albeit in broad brush terms.

This modelling makes crystal clear both the environmental and economic benefits arising from more sustainable travel. As might be expected, there is a significant impact on emissions of greenhouse gases from Wales. A sustained change in travel behaviour of the scale seen in English pilot towns could see a fall in annual private vehicle kilometres travelled of 1.5bn, and a net saving of 170,000 tonnes of CO₂e per annum, even accounting for increased public transport journeys.

Perhaps less intuitive is the impact such a shift in behaviour would have on the Welsh economy. Lower distances travelled by private car mean lower spending by Welsh households on exchequer taxes and (largely imported) fuel. These savings would be in part transferred to public transport in Wales or, where journeys are taken by non-motorised means, increased household disposable incomes. Both of these comprise an economic benefit for the Welsh Economy. WERU estimates the net economic impact of Smarter Choices at over £11m of gross value added annually, and supporting an additional 300 full time equivalent jobs in Wales.

21 Living Streets, 'New Research shows that friendships on busy streets are cut by more than 75 per cent' <http://www.livingstreets.org.uk/news/uk/-/driven-to-excess>

22 <http://www.independent.co.uk/news/business/sustainit/commuting-the-end-of-the-road-1605547.html>

23 An evaluation of the London Borough of Sutton Smarter Travel scheme found that 81 per cent of people believed it was an appropriate investment for Sutton, and that it was "popular and well received" - Smarter Travel Sutton, 'Third Annual Report' 2010 http://www.smartertravelsutton.org/_uploads/documents/STS_thirdANNUALREPORT2010_V07.pdf and Smarter Travel Sutton 'Lessons Learned' Nov 2009, p10 http://www.smartertravelsutton.org/_uploads/documents/1STSLessonsLearnedFinal.pdf

24 Sustrans, 'Leading the way in travel behavior change' http://www.sustrans.org.uk/assets/files/travelsmart/behaviour_change_ff36.pdf

25 Ibid.

26 See Appendix A for full methodological detail

2. NATIONWIDE HOME ENERGY REFURBISHMENT

SUMMARY

Through the implementation of a nationwide home energy refurbishment programme, existing housing in Wales offers the potential to make deep and immediate cuts in emissions. Through a combination of bespoke energy efficiency upgrades and the installation of microgeneration systems across the housing stock, emissions reductions in line with, or beyond, 40% are achievable by 2020.

Any government that takes seriously the need to reduce emissions by 40% or above by 2020 must focus on housing, as it is responsible for about a fifth of Welsh national emissions²⁷. It is likely that to 2020, or even to the longer-range targets of 80% reductions by 2050, the residential sector will have to deliver far more than its share of emissions reductions to balance up the shortfall from sectors perceived as trickier to deal with such as aviation or agriculture.

Any such scheme will have to go far beyond the basic measures, such as loft and cavity wall insulation, which have previously received focus²⁸. While it is essential these measures are done, and done to a high standard of workmanship, the challenge is such that we need to adopt a whole house approach to achieve sufficient carbon savings.

POLICY BENEFITS

The proposition for a home energy refurbishment programme:

At its most basic, this sort of programme **reduces energy use, cuts carbon, reduces fuel bills, creates jobs, bolsters people against fuel poverty** (although obviously supporting policies are required and the market anticipation is that fuel prices are only going up), and **improves health and wellbeing** at home. At a UK level it makes it easier to meet carbon budgets and European renewables targets.

And if the **Green Deal package** for Wales is shaped correctly, the package should become an easy sell to householders:

Pay nothing, get lower fuel bills and a much more comfortable and, over time, valuable property.

The immediate call is for the establishment of a comprehensive strategy capable of delivering home refurbishment at the scale needed. As set out above, this must not just be geared to the delivery of basic insulation measures,²⁹ but whole house solutions capable of dealing with Wales' swathes of homes that are going to be trickier or at least more expensive to deal with.

27 National Assembly for Wales Sustainability Committee - http://www.assemblywales.org/bus-home/bus-committees/bus-committees-third1/bus-committees-third-sc-home/inquiries_sd/inquiries_-_carbon_reduction/carbon_reduction-household/carbon-wag_residential_response.htm

28 A recent WWF report into a non-means tested, area-based approach in Scotland has shown positive results in terms of take-up, but found that it didn't lift people out of fuel poverty because they didn't go beyond the basics in terms of the energy efficiency measures undertaken – Achieving Our Potential - http://assets.wwf.org.uk/downloads/achieving_our_potential.pdf

29 There are currently 250,000 homes in Wales with unfilled cavity walls and a further 3,000 with completely uninsulated lofts. Some 537,000 lofts are thought to have less than 100mm insulation. The amount recommended by building regulations is 270mm.

By 2020, to stand any chance of meeting the residential sector's contribution to 40% cuts, the Welsh strategy needs to include:

- The refurbishment of at least one third of the entire housing stock – over 400,000 homes – on a whole-house basis, cutting the carbon emissions in each home by 60% or more. Recognised refurbishments to this level do not exceed double figures across Wales.
- Action on the worst performing housing across the entire country. By 2020 no home should have an Energy Performance Certificate rating below D³⁰ (i.e. upgrade all E, F and G rated properties).

These measures, while generating major benefits, will not achieve the target of reducing emissions from the residential sector by at least 40% by 2020. The Assembly Government must also encourage owners of the remaining houses to adopt significant energy efficiency measures. In addition, it must work to reduce the carbon emissions from electricity used in the residential sector (and elsewhere) by doing all in its power to decarbonise the grid by promoting the generation of electricity from renewable sources.

In 2006, 243,000 Welsh households – or more than one in five - were in fuel poverty³¹. Between 2004 and 2008 the numbers in fuel poverty increased significantly despite concentrated WAG efforts to address the problem. Between 2004 and 2009, the cost of domestic energy more or less doubled in the UK.

This speaks to the truth that regional or national governments cannot buck the markets. Energy supply costs are moving inexorably upwards, even as renewables or new nuclear might come on stream. At the same time, Wales has targeted 2018 as the absolute eradication date for fuel poverty from households in Wales.

Energy efficiency programmes will be key in delivering on this promise, especially as the Welsh Assembly's Minister for Environment, Sustainability and Housing, Jane Davidson, AM, said:

"I accept this is an ambitious target but I see no reason to aim low. Making homes more energy efficient is just one of three factors that contribute to fuel poverty – and the Assembly Government cannot control people's income and global fuel prices. But we must aim to do all we can as far as is reasonably practicable to end fuel poverty."

The WAG strategy sets three key objectives underlying the fuel poverty strategy, which are:³²

- Social – reduce the impact of fuel poverty on householders in Wales and, as far as reasonably practicable, eradicate fuel poverty.
- Economic – create green jobs and business opportunities for the people of Wales.
- Environmental – reduce the greenhouse gas emissions in the domestic sector, contributing to the Welsh Assembly Government's target to reduce greenhouse gas emissions by 3% per year in areas of devolved competence.

This proposed home energy refurbishment programme for Wales would deliver against all of those objectives. The consequences of fuel poverty are real and significant. At a time of austerity, the ability of the poorest people in Wales to heat their homes will impact more than almost anything else on their wellbeing – and for some might even cost their lives.

The Welsh Assembly Government must consider the need for this form of comprehensive strategy as, although it has made in-roads through the Home Energy Efficiency Scheme³³ and the commitment of European Structural Funds to this agenda, the full picture of emissions reductions is far from clear. The

30 SAP rating of 55 or above

31 <http://wales.gov.uk/docs/desh/publications/100723fuelpovertystrategyen.pdf>

32 Ibid

33 <http://www.heeswales.co.uk/>

strategy must set out in detail a robust delivery programme – sufficiently targeted to tackling homes in the first wave of the programme which span the dual criteria of a large carbon deficit and appropriate levels of social need – and sufficient sustained financing from government, private and innovative sources.

THE GREEN DEAL FOR WALES

While many aspects of this programme sit within the competence of the Welsh Assembly Government, there are several aspects that are required for the full implementation of this programme, which lie within the responsibility of the UK government.

This programme of refurbishment will be expensive to deliver, but it stands out as an area where suitable, innovative mechanisms (based on a Pay-As You-Save model) are in development to ensure the monies are raised primarily from private sector sources. This mechanism – the Green Deal as it is being badged by Whitehall – enables third party finance to be used to carry out the home refurbishment and ensure the householder is not out of pocket. The finance provider, through a charge on the property, recoups the outlay (plus interest, as the effective return on investment) from the savings in energy bills, typically over a twenty-five year repayment period. The householder pays nothing up-front, but gets the residual energy bill reductions after the charge is paid.

The crucial element for the success of the Green Deal mechanism – and the one which is within Whitehall's purview – is the ability to attach the charge to the property rather than the householder³⁴, which is not currently possible in the UK. Primary legislation is required for this, and this home finance element forms the central plank of the Energy Security and Green Economy Bill, which is going through the UK Parliament in 2011³⁵.

The Welsh Assembly Government must, as a matter of urgency, ensure that Wales will be able to craft the appropriate Green Deal to deliver a Welsh-specific refurbishment programme here, and must ensure it is enabled to do so. Without the full scope of necessary provisions in this Bill, the Assembly may find itself prohibited from exercising the full range of refurbishment options required.

The Bill must put in place specific provisions of the Green Deal, in particular:

- A Pay-As-You-Save scheme to cover both basic and advanced energy efficiency, microgeneration and other refurbishment options, at low interest rates to encourage take-up. Estimates vary but a conservative estimate is that an average cost of at least £15,000 will be needed to adequately refurbish each dwelling to 60% carbon reductions or beyond. Many will cost significantly more than this, and it quickly becomes clear that most people will need help, at low or no cost. The scheme must be designed to ensure it can be utilised cross-tenure.
- Reform of Energy Performance Certificates (EPCs) to ensure that homeowners have access to high quality, reliable information to enable them to make informed choices. Every home in Wales will need a plan setting out how to reduce its carbon emissions by 60% or more, delineating a stepwise approach to achieve it. While every home does not need to be refurbished in one hit, it is notoriously difficult to get access to people's homes and we must ensure that we maximise every opportunity. Understanding each home's full energy refurbishment potential is the first step in this process.
- Establish a minimum standard of energy efficiency for private rented properties from 2016. Rented property is, as a tenure, the worst maintained sector of the UK housing stock, with the lowest levels of energy efficiency. The private rented sector houses large numbers of the most vulnerable households and those living in fuel poverty³⁶. This legislation must set a legal minimum level of energy efficiency for these properties, and a date by which it will be an offence to let properties

34 http://www.ukgbc.org/site/document/download/?document_id=670

35 <http://www.parliament.uk/briefingpapers/commons/lib/research/briefings/snsc-05559.pdf>

36 Less than 10 per cent of all households in Wales are rented privately but, but 36 per cent of these were fuel poor – 41,000 households in 2008 - <http://wales.gov.uk/docs/statistics/2010/101126sdr2052010en.pdf>

that do not meet this standard. It is important that suitable incentives and access to the Green Deal mechanism are made available and suitably marketed to landlords to drive improvement ahead of the regulatory curve.

Wales needs to set the pieces in the context of the whole, to confirm how many homes it will improve each year, and to what extent, within the framework of the need to refurbish over 400,000 homes over the next ten years. This will provide a clear policy signal to infuse confidence in the market and industry in Wales.

As often happens in the policy development process, the Green Deal has been stripped back from the more robust original policy. The Welsh Assembly must ensure it has the powers to include the installation of microgeneration technologies under the scheme. The message coming from Whitehall is that the system of feed-in-tariffs³⁷ to reward households who install home energy generation systems will suffice. However, without a financial mechanism to assist people to access these technologies in the first place, they may remain the preserve of the cash-comfortable.

Any campaign to push forward this programme has a large hill to climb in overcoming the disinterest and in many cases the unwillingness of householders to undertake refurbishment work. Recent householder research by WWF and the Great British Refurb campaign³⁸ has shown that a system of financial incentives to kick-start this will be necessary to ensure sufficient take-up. This will be essential to drive the creation of a market around the Green Deal. A system of council tax rebates, which lie within the gift of the Welsh Assembly Government to control, were a very strong motivator for householders. Almost half (49 per cent) say that they would take up a Green Deal package if this were to include a one-off council tax rebate of £500.³⁹

The refurbishment programme must be rolled out on an area-by-area basis according to need. The twin necessities of carbon mitigation and fuel poverty alleviation can be blended by using an area-based approach which targets very low performing homes in areas of need – for instance by tying this into the wider low carbon zoning work in the Heads of the Valleys area. A considered approach to this programme is necessary to ensure no problems are raised by the potential conflict between the carbon reduction and fuel poverty priorities. In some instances, if a policy is chasing deep carbon reductions, vulnerable households and those in fuel poverty may not necessarily deliver the deepest cuts. This area-based targeted approach is not being posited by the UK government, which is veering away from the area-based approach, despite its obvious benefits, SCCC feels this will be essential in order to engage with 'hard to reach' groups which do not respond to general marketing campaigns; a non-means-tested approach is the only effective option available.

ECONOMIC AND EMISSIONS BENEFITS

A large-scale home energy refurbishment programme for Wales would see localised job creation in the thousands. A WWF report⁴⁰ published earlier this year established that the rollout of a UK-wide home refurbishment programme of this scale and depth could create over 68,000 full time (direct) jobs in installation and maintenance sectors every year of the programme rollout⁴¹. A further 100,000 (indirect) jobs would be created each year in the supply chain to bolster this programme. Research has shown that of all low carbon investment pathways, investing in energy efficiency creates more jobs than any other (with existing housing refurbishment coming out extremely strongly on this measure, not least because it's job creation impact tends to be heavily localised)⁴².

37 <http://www.energysavingtrust.org.uk/Generate-your-own-energy/Sell-your-own-energy/Feed-in-Tariff-scheme>

38 <http://www.greatbritishrefurb.co.uk/projects-and-events>

39 At a much lower rate of rebate, British Gas ran a similar large-scale pilot in England across 60 local authorities, and take up was good - <http://www.britishgas.co.uk/energy-efficiency/products/home-insulation/council-tax.html>

40 Retrofitting the UK's homes: opportunities for the economy - http://assets.wwf.org.uk/downloads/wwf_retrofit.pdf

41 This far exceeds the Secretary of State at DECC, Chris Huhne's estimate of a total of 250,000 under the Green Deal rollout by 2030 - http://www.decc.gov.uk/en/content/cms/news/pn10_104/pn10_104.aspx

42 <http://www.zerocarbonbritain.com/index.php/zcbreportmenu/category/1?download=1%3A2030>

Modelling undertaken by WERU has shown a similar scale of economic benefits could be captured in Wales following large-scale domestic refurbishment. The circa £700m per annum investment that would be required to enable the refurbishment of 400,000 properties to the 60%-saving standard by 2020 could result in a net addition of £300m to Welsh gross value added in each year of activity, showing that much of the spending might be retained in Wales in this initial ten-year period. With refurbishment interventions typically labour intensive, the net employment benefits associated with the programme could total around 20,000 full time equivalent workers employed per annum. Such a figure is far from trivial, with the entire construction sector in Wales currently equivalent to 70-80,000 FTEs, and some significant supply-chain opportunities, for example with reference to insulation materials.

Over the longer term, Welsh households would continue to reap the benefit of lower fuel use at a time of increasing fuel costs; protecting disposable income for households, and lowering fuel imports (and thus economic leakage) for Wales⁴³.

The saving of a net 24m tonnes of carbon-equivalent emissions over a thirty-year period is also, then, a huge economic opportunity. Not only would opportunities open in some of the poorest parts of Wales, but also with Welsh SMEs potentially extremely well placed to benefit. There is the opportunity here for significant support for Welsh employment, and also to drive the upskilling of important parts of the workforce and the competitive position of Welsh business. These outcomes will not arise naturally, however, but require a serious, long term, fully integrated and well resourced strategy to develop the Welsh green skills base.

3. GREEN TECHNOLOGY SKILLS TRAINING

SUMMARY

SCCC recommends a programme of investment in the targeted development of a Welsh base of skilled sustainability practitioners across a range of sectors and thematic areas, with particular emphasis on green technology and wider construction and installation skills. While not delivering demonstrable emissions reductions in its own right, the development of this network of suitably trained professionals is an essential supporting programme to enable the delivery of multiple climate interventions, such as those outlined in this set of policy recommendations. This could be an aid to Wales' current training programmes and would stimulate the necessary growth in employment capacity as multiple policies scale up their delivery requirements⁴⁴.

Strategic training centres would be developed around the country, targeting areas that meet a twin test of high unemployment and future work capacity. This will not be so relevant to the manufacturing side, but will be important for installation and maintenance to ensure that we do not unintentionally lock people in to high carbon commuting if the centres are not developed in the locations where the work will be required. Better trained, and newly trained workers will be needed across sectors, and must be incentivised to remain and operate in Wales. Properly applied this new training regime will be a major factor in ensuring Wales' competitiveness in the UK and overseas jobs markets and will directly aid in the development of a more resilient and responsive Welsh workforce.

THE ECONOMIC CASE FOR THE IMPORTANCE OF SKILLS

A comprehensive review of the green skills landscape by WERU reveals a number of key factors. Firstly, the 'green economy' has been identified as a key driver of future prosperity by government both here in the UK, and across the globe, from the US to Australia and South Korea. These governments and economies are not hanging around, debating how to move forward in a time of austerity; they are investing substantially in the green skills agenda and they are doing it now.

Secondly, skills and training are key to economic performance, both for individual firms and at economy scale. A lack of training has been shown to hold back firms, stunting growth, productivity and profitability. At the macro economic, whole-economy level, the human capital of the workforce drives prosperity. For the individual, skills and training matter, improving earning potential and life outcomes.

Thirdly, Wales starts from an unenviable position. Not only does Wales enjoy a low proportion of UK research and development, but it has few large construction companies within which green developments can happen. Moreover, the nature of the construction sector in Wales, with its SME base, is a problem because small companies are less likely to train their staff than large. These companies are likely to be difficult and time consuming to target in any skills improvement endeavour.

The above points mean that if Wales is to even keep pace with the green skills agenda, interventions here must be quicker, more forceful and better integrated than those elsewhere.

⁴⁴ See earlier ref to scale of job creation required to meet the demands of a UK home refurbishment programme - Retrofitting the UK's homes: opportunities for the economy - http://assets.wwf.org.uk/downloads/wwf_retrofit.pdf

POLICY BENEFITS

In the construction sector alone, Wales will soon experience an upsurge in the need for both high and low skilled professionals – skilled builders, microgeneration installers and all the associated trades-people. This will be stimulated by regulatory and policy changes. However, while challenging in its own right, this will open up opportunities for thousands of people to enter the construction market in design, manufacture, specification, installation and maintenance.

As noted in the introduction, disappointingly the Green Jobs Strategy⁴⁵ does not feature prominently in the current Welsh economic renewal plans. SCCC recommends that the focus of the jobs strategy, which is geared towards various technologies and how they interrelate, should be reformulated to weave in this sustainability skills development and spatial planning approach (in terms of co-locating skills developments with unemployment and work capacity).

This redevelopment of the Green Jobs Strategy could be tied in to any review of the higher education system in Wales. A component of this training initiative is to ensure that the necessary capabilities filter down through the system to the small companies who carry out the lion's share of the work in many of these markets, not least the refurbishment sector.

This proposal would ensure a reliable, Wales-wide supply of trained staff, increasing over time and with rising demand, for renewable heat technology, retrofitting, sustainable new build technologies, inspection etc.

It will be essential to build on the work being developed by the Wales Low/Zero Carbon Hub⁴⁶, which is drawing together the Built Environment Forum in Wales, and Construction Skills⁴⁷, to map out the future training requirements for the Welsh construction and renewables sector. The Welsh Assembly's Department for Children, Education, Lifelong Learning and Skills has been focussing to date on the skills requirements for renewables delivery (on- and offshore, as well as microgeneration), train the trainer programmes⁴⁸ and getting sustainability embedded in schools curricula. And in addition, SummitSkills together with the Existing Homes Alliance Cymru⁴⁹ are developing microgeneration skills plans. What is essential from a necessarily revitalised Green Jobs Strategy is that it draws together all of these disparate threads of activity and matches the knowledge of what skills are required with the appropriate processes (over the correct timescales) to make sure they are put in place for the built environment, the renewables industry and beyond.

A barrier that must be tackled is the cost associated with this skills development process. However, in difficult financial times, the strategic partnership approach adopted by the British Gas Green Skills Training Centre (GSTC) at Tredegar provides a promising model.

CASE STUDY

The Gas Green Skills Training Centre (GSTC), which is a component in the wider programme to turn the Heads of the Valleys region into a Low Carbon Zone, was the first of its kind in the UK. Formed by a strategic public-private partnership between British Gas, the Welsh Assembly Government, JobMatch, Jobcentre Plus, SummitSkills⁵⁰ and Blaenau Gwent County Borough Council⁵¹, it will give

45 <http://wales.gov.uk/docs/det/publications/090709capturingthepotentialagreenjobsstrategyforwalesen.pdf>

46 <http://www.sustainablebuildingportal.co.uk/pages/Wales%20LZC%20Hub/Current%20work%20stream3>

47 One of the relevant Sector Skills Councils, Construction Skills has a remit to be the means by which employers can influence the supply of education and training and business support across the UK in order to:

- Improve performance and productivity
- Address skills gaps and shortages
- Give its workforce greater opportunities for training and development
- Supported by more responsive education and training provision

48 With the Lifelong learning Council

49 <http://www.sustainablebuildingportal.co.uk/pages/Wales%20LZC%20Hub/Existing%20work%20stream>

50 The Sector Skills Council for Building Services Engineering

51 <http://www.britishgasnewsroom.co.uk/2010/05/uk's-first-green-skills-training-centre-opens/>

green training to more than 1,300 people each year. The recruits at the cutting edge training centre – which features functioning training equipment for homes that are more difficult to treat, such as single brick walls, and timber-framed properties – will be drawn both from internal British Gas employees and from local long-term unemployed people⁵². They will be able to do training and qualifications on energy assessment and green technology installation and maintenance, covering smart gas and electricity meters, solar thermal panels, photovoltaic panels that generate hot water and electricity and combined heat and power boilers.

This policy priority from SCCC fits within the Welsh Assembly's five priorities for economic development, one of which is "broadening and deepening the skills base"⁵³, and developing centres in a targeted fashion, such as at Tredegar, will ensure the creation of job opportunities in the emerging green economy where they are most needed.

Working with Summit Skills, and the other Sector Skills bodies, it will be necessary to ensure that these training regimes permeate all aspects of relevant skills training, from Continuing Professional Development courses to train-the-trainer activities as well as the more formal Further and Higher Education routes.

LOW CARBON CONSTRUCTION SKILLS ACCREDITATION SCHEME⁵⁴

A well-marketed, recognisable accreditation scheme will be an essential element of the delivery of a Welsh Green Deal to householders. People will need to have the comfort of knowing that the Green Deal marquee on a Googled local builder's site, or in the plumbing section of the Yellow Pages, will ensure they are entrusting the low carbon refurbishment of their home to someone with the necessary abilities and aptitude.

This will be essential to build the requisite levels of consumer confidence in the Green Deal to help drive mass take-up. In addition, investor confidence will be bolstered by such a quality assurance programme, to let them hedge against prospective exposure through payment defaults upon shoddy workmanship.

Such a scheme, which should incorporate existing quality assurance brands in the industry, must be government-backed to add legitimacy and demonstrate the long-term policy commitment to the roll out of the Green Deal. It must cover the full gamut of home refurbishment activities; from basic to more complex insulation and energy efficiency measures, through to microgeneration systems.

Repeated breaches of the accreditation scheme regulations by trades people would result in removal of their accreditation, rendering them incapable of offering access to the Green Deal financial package to householders.

LOW CARBON CONSTRUCTION COLLEGE

With the funding model for post-16 education changing, now is an ideal time to assess the suitability of education and training provision to enable the green skills agenda. There seems to be a prima facie case for a Low Carbon Construction College for Wales where it is needed most: centred in the South Wales Valleys and dedicated to providing local people and businesses with the skills they need.

The college could link closely to the accreditation scheme, preparing students to work within the new

52 The Heads of the Valleys area has the lowest employment rate in Wales – 64%, versus 71% nationally.

53 Economic Renewal: a new direction, 2010 - <http://wales.gov.uk/docs/det/report/100705anewdirectionen.pdf>

54 Based on the Green Deal Quality Assurance and Accreditation paper by the Existing Homes Alliance.

construction landscape by providing appropriate and up to date skills and approaches, as well as developing wider business skills. The college could also help develop the alternative forms of business and social enterprise that will be needed to ensure the widest inclusion in the new green economy. Similarly, inter-business co-operative and collaborative approaches to working might be developed that helps break down some of the barriers to performance raised by Wales' large population of SMEs.

Existing businesses must not be forgotten. The link to an accreditation scheme could incentivise businesses to engage with the College (to gain or retain accreditation) and here, through the roll out of a 'continuing professional development' mentality to the Welsh construction sector, significant wider economic competitiveness and performance benefits could be gained. At the same time, individuals with few qualifications and low exposure to education and training structures gain new skills, qualifications and competencies, enhancing their life chances.

APPENDIX A

SMARTER CHOICES WALES: ECONOMIC AND CARBON POTENTIAL

A1 SMARTER CHOICES

This Appendix presents the economic modelling and detailed results that inform our estimate of the potential economic impact and emissions savings associated with the successful roll out of a Smarter Choices Wales programme as outlined in the main report.

It is important to note that this Appendix does not comment on the achievability of SC on terms of modal shift, nor on the reasonableness of assumptions regarding project cost, with these drawn from the English Sustainable Travel Towns projects and amended to the Welsh context.

Clearly, behaviours, travel purposes, distances and available modes are different in English towns than across Wales and this will impact on the scope, scale and nature of any SC project in Wales. On some (e.g. rural) areas switches to modes alternative to the private car will be difficult, and SC might major on reducing the need for travel, for example through much improved e-service facilities, or video-conferencing for business. In the linear South Wales valleys there is substantial opportunity for modal shifts to less polluting modes, but only if enabled by further investment, or significant behaviour change on the part of (particularly) workers and businesses to address peak flow capacity constraints.

This Appendix however does scale the potential economic implications and carbon savings associated with a significant modal shift towards walking, cycling and public transport. Not all of these impacts are quantifiable due to uncertain behavioural impacts, and very poor data on the cost of public transport.

A2 CONCEPTUAL APPROACH

The impact of smarter travel choices on carbon emissions is intuitively relatively straightforward, and discussed in some detail in the reports on the English Sustainable Travel Town experience¹. A reduction in total distances travelled using fossil-fuel powered transport is allied to a switch to less polluting modes (per passenger kilometre) for those that remain, leading to less fuel burned and lower levels of green house gas (GHG) emissions, here mainly carbon dioxide. There will be indirect emissions effects; for example less fuel may be refined in Wales as well as bought and burned, further reducing carbon emissions (with fuel refining itself very carbon-intensive).

The potential impact of modal shift on the regional economy is slightly more involved and complex. A reduction in car trips will have the primary impact of reducing the amount of fuel bought and burned in Wales⁵⁵, and hence a reduction in economic activity with less fuel refined in Wales (insofar as Welsh households purchase fuel refined at Milford Haven); less sold in Wales; and lower employment, output and value added in relevant sectors. There will however be balancing impacts. As people switch from cars to buses and trains (in part), there will be increased levels of economic output, value added and employment amongst bus and train drivers and ancillary transport occupations.

Moreover, this shifting economic demand will have 'indirect' effects. Sectors such as fuel refining and distribution, and public transport, have supply chain links to other Welsh companies, whose economic

⁵⁵ Assuming here Smarter Choices does not result in large numbers of households giving up their cars entirely, or giving up a second car which would have concomitant impacts on household's fixed rather than marginal transport costs – this being far harder to model.

fortunes will rest in part on their sales to these consumer-servicing sectors. These multiplier effects will differ between sectors, and must be weighed in any economic assessment.

These net effects can be accounted for in a regional modelling approach which integrates the economic activity and resultant emissions of the Welsh economy in a single, consistent framework; the **Input-Output Tables for Wales**ⁱⁱ. It is important to understand that here we can only model the within Wales economic or environmental impacts of Smarter Choices; we cannot establish the emissions reductions associated with the refining of fuel imported from Merseyside for example, or any consequent job losses at that refinery.

A3 ASSUMPTIONS

Following discussions with Sustrans and other partners during the SCCC workshop, we assume that the impact of Smarter Choices Wales is consistent with that achieved, on average, across the three English Sustainable Travel Towns, with a further assumption regarding a similar level of spending per head at £10; with this in England focussed on the breaking down of perceptual barriers regarding the relative time convenience of private and public/non-motorised transport options (ibid).

There are important assumptions that must be made with regard to the switch to public transport, where there is substantial spare capacity outside peak hours, but very little (on commuter trains particularly) at peak times. Increased public transport patronage may result therefore in no additional vehicle journeys if the take up is 100% serviced by a reduction in spare capacity, or in an 18% increase in vehicle journeys and kilometres if loading remains the same and extra trains and buses are required. The truth is of course, somewhere in the middle: increased patronage would lead to both increased loading and more capacity required (either with larger buses and longer trains, which would mean a small increase in total sector emissions, or by additional vehicle journeys, leading to a linear increase in emissions).

In the English STT case any increases in sub/interurban rail journeys were not noted. Here then we assume the modal split in Wales between bus and rail will remain unchanged⁵⁶; i.e. both increase by 18% from their existing level of patronage.

The economic and environmental impacts of Smarter Choices rely in part on the assumptions made in this regard but the most likely outcome is very difficult to judge, with even evidence from other countries very limited. We therefore present three scenarios to enable readers to judge the scale of the issue, but with the 0% and 100% vehicle journey increases both unlikely to occur. In the absence of other evidence, we present the middle scenario as a 50% split between increased loading and increased vehicle journeys. Table 1 summarises.

Table A1 – Modelling Assumptions

	Percent		Vehicle km (m)
Reduction in private vehicle km	-11		-1,485
Increase in passenger bus km	18	100% increased loading	0
		50:50	11.1
		100% increased vehicle km	22.2
Increase in passenger train km	18	100% increased loading	0
		50:50	1.99
		100% increased vehicle km	3.98

Key Sources:

National Rail Travel Survey Final 2008 Reportⁱⁱⁱ
 Annual bus statistics, Great Britain 2009/10^{iv}
 Welsh Transport Statistics 2009^v

56 Although this modal split is itself not straightforward to assess given current data.

A4 METHODOLOGY & DATA

Following the above conceptual approach, the **economic** impact of Smarter Choices is estimated in the following fashion. Firstly an economic shock to the fuel distribution and refinery sectors is simulated by reducing the level of consumer spending on private vehicle fuel in Wales. This provides an estimate of the gross reduction in economic activity in Wales associated with the reduction in demand (and allowing for the leakages due to taxes and imports associated with the fuel purchased).

The increase in spending associated with increased public transport patronage is far harder to estimate, even after deciding upon the relative incidence of increased loading or increased vehicle journeys. Some public transport is subsidised and is heavily regulated by government via transport franchises: thus, the fare paid by the new patron will not directly equal increased revenue for the operator. Secondly, it is impossible to estimate the cost-per-km of public transport fares at a Wales level due to limitations in travel datasets and differences in Welsh-English bus funding.

Our alternative approach has been to examine UK statistics on gross revenue per passenger km to estimate the additional economic activity in Wales associated with increased bus patronage^{vi}. For trains, with the financial details of franchise agreements in commercial confidence, we have examined the distances travelled and gross turnover of Arriva Trains Wales in conjunction with rail loading factors to proxy revenue per passenger km^{vii viii}.

Increases in rail and bus revenue (and hence employment) are here assumed to be proportional to the increase in vehicle journeys not increases in passenger numbers. This clearly ignores a great deal of complexity, but for public transport is a more appropriate scenario than linking revenue (and hence in the model, employment) to increased passengers: effectively, this reflects the fact a quarter-full bus has similar employment requirements (one driver) to a half-full bus.

Our economic modelling takes full account of output, and value added employment impacts in sectors supplying transport, as job losses or gains have wider ripple effects through decreases or increases in wages and hence household spending^{ix}.

The **emissions** modelling of the approach follows in part from the economic modelling of emissions savings of posited changes in behaviour directly related to fuel burned using standard DEFRA estimates of emissions per passenger kilometre for affected modes^x. We must also, however take account of indirect emissions, and here we use the Input-Output Tables for Wales and their environmental extensions to estimate the CO₂e multipliers for private and public transport, as economic activity ebbs and flows as described in the economic analysis above. Here, for every unit of carbon emitted directly in transport sectors, we can estimate the emission of carbon along the supply chain (for example, in the hypothetical case of electrical trains or buses, the carbon analysis would include the indirect emissions at supplying Welsh power stations). The carbon analysis is fully integrated with the economic analysis, using Welsh-bespoke data on carbon emissions by source supplied by AEA Technology^{xi}.

As with economic effects, the gross savings in private car emissions will be offset by increased emissions of trains and buses, with this related to the assumptions adopted regarding increased loading versus increased vehicle journeys⁵⁷. The following section presents the results of our analysis.

57 Increased loading will of course decrease fuel consumption somewhat and hence increase emissions even in the absence of increased vehicle journeys but this will be of secondary importance with the weight of passengers a minor part of overall vehicle gross weight. We therefore do not include this in our analysis.

A5 RESULTS (1)

THE ECONOMIC IMPACT OF SMARTER CHOICES WALES

Assuming a per-litre cost of £1.2, Welsh residents would spend some £162m less on fuel following lowered car kilometres as a result of smarter choices. Much of this impact would not, however translate to a reduction in the demand for Welsh goods and services, and hence in value added and employment. This is because the majority of the £162m comprises leakages from Wales in terms of exchequer taxes (around 60%) and some refining costs (around 30% of the gross fuel cost and with well over half our vehicle fuel imported from non-Welsh refineries^{xii}). In fact, only £27.5m of this total is estimated to be a loss to Welsh demand, focussed on fuel distribution and retail.

This loss of revenue leads to economic losses in Wales; some £10.6m is lost in Gross Value Added (GVA) and there are significant employment losses, again largely in distribution and fuel retail, totalling around 310 full time equivalents (FTEs).

These losses are, however, more than offset by increases in economic activity as a result of Smarter Choices in the bus and rail sectors. As public transport is a service rather than a commodity; it cannot be imported (as fuel can). We estimate then that the switch to these modes adds around £22m to value added in Wales and around 600 FTE jobs.

Despite, then, the lower vehicle and passenger kilometres travelled in total following Smarter Choices, there is a net addition to Welsh GVA of around £11.2 and a net positive impact of 310 FTE jobs as a result of Smarter Choices (Table 2).

Table A2 - The Economic Impact of Smart Choices (50:50 Assumption)

	Car Use	Bus Use	Rail Use	Net Change
Change in passenger km (million)	2,530	105	40	-2,385
GVA (m)	-10.6	8.9	12.9	11.2
Employment FTEs	-290	310	290	310

Sources Additional To Table 1:

Input-Output Tables for Wales (ibid)

Annual Business Inquiry (Part 1)^{xiii}

A6 RESULTS (2)

THE EMISSIONS IMPACT OF SMARTER CHOICES WALES

Similar offsetting impacts on carbon (equivalent) emissions are seen when modelling the environmental impact of Smarter Choices. Here, however, there is a more dominant relative reduction in emissions due to;

- the large decrease in motorised passenger kilometres;
- the relatively lower per passenger pollution associated with bus and rail compared to private cars
- the further lowering of per-passenger emissions associated with increased loading of public transport vehicles.

Smarter Choices, as outlined, delivers a gross reduction in CO₂e as a result of reduced car use across Wales totalling almost 228,000 tonnes. The majority (92%) of this impact is savings associated with the burning of fuel, the remainder being lower emissions in refining, distribution and other supplying sectors in Wales⁵⁹.

58 It is worth a reminder here that in our model employment reacts in a linear fashion to changes in output. In reality a loss in sales revenue of, for example, 10% may lead to a lower-than-10% fall in employment if, the fall in sales does not lead to the closure of a proportionate number of retail outlets.

59 All emissions estimates herein exclude any consideration of emissions arising outside Wales

There is meanwhile an increase in the emissions of buses and trains responding to increased demand, this totalling around 12,850 tonnes of CO₂e (direct plus indirect).

The net emissions impact across the whole Welsh economy of Smarter Choices as outlined here therefore might be around 215,150 tonnes of CO₂e.

Table A3 - Carbon Emissions Impacts of Smarter Choices (50:50 Assumption)

	Car Use	Bus Use	Rail Use	Net Change
Change in passenger km (million)	2,530	105	40	-2,385
Emissions (direct) (tCO ₂ e)	-199,620	9,190	1,200	-189,230
Emissions (indirect) (tCO ₂ e)	-28,390	2,220	250	-25,920
Emissions (total) (tCO ₂ e)	-228,000	11,400	1,450	-215,150

Sources Additional To Table 1 & 2:

AEA - Emissions of the basket of 6 Kyoto GHGs according to Devolved Administration (ibid)

A7 RESULTS (3) ACCOUNTING FOR INCOME AND SUBSTITUTION EFFECTS

Sections A5 and A6 above relate the initial economic and carbon responses to a Smarter Choices-led change in travel modal split. This is not the end of the story, however. The switch to smarter choices implies a significant net saving for each Welsh household that reduces motorised distances travelled.

Pulling together information from a range of DfT statistical sources^{xiv}, albeit somewhat limited, implies an average fare in Wales of around 9p per passenger km for local bus, and 11p per passenger km for rail. From the above tables, we can deduce that additional public transport fares paid by Welsh householders would total £14.5m in the event of a successful Smarter Choices programme⁶⁰. This contrasts with the £162m saved in private fuel costs.

Welsh households might then be better off to the tune of £147.5m annually as a result of Smarter Choices (around £165 per car-owning household). There may be a variety of consequences of this. Firstly, households may save this additional money in total, meaning the effects discussed in A5 and A6 are the totality of Smarter Choices impacts. They may, perhaps following wider behavioural change and attitudes following climate change messaging, use this money for further energy efficiency investments, increasing the carbon savings impacts of Smarter Choices. Or thirdly, they may spend the money in other ways with varied emissions and economic consequences.

Table 4 makes the assumption that the additional disposable household income released as a result of Smarter Choices is spent on commodities and services that households already buy and in similar proportions, and amends the initial results to take account of these income/substitution effects.

Table A4 - The Impact of Smarter Choices (inc. Income Effects)

	Car Use	Bus Use	Rail Use	Income/ subs effect	Net Change
Change in passenger km (million)	2,530	105	40	n/a	-2,385
GVA (£m)	-10.6	8.9	12.9	100.5	111.7
Employment FTEs	-290.0	310	290	2,120	2,430.0
Emissions (direct) (tCO ₂ e)	-199,620	9,190	1,200	-	-
Emissions (indirect) (tCO ₂ e)	-28,390	2,220	250	-	-
Emissions (total) (tCO ₂ e)	-228,010	11,410	1,450	44,800	-170,350

⁶⁰ As earlier noted the fares paid by passengers do not equal the operator's revenue. For example, for local buses the passenger fare comprises around half the total cost.

Assuming households spend their additional income in prior-established ways has significant impacts. There is a significant effect on Welsh GVA of over £100m, and with this extra spending supporting over 2,100 FTE jobs in Wales. These figures, much larger than the losses due to private vehicle fuel sales, further emphasises the large proportion of fuel purchases which leaks straight out of the Welsh economy, in contrast to other sectors.

These additional purchases also have a significant effect on carbon emissions however, with these increasing by 44,800 tonnes as a result of households' increased demand for Welsh goods and services. Further, our modelling cannot currently account for the carbon emissions associated with the increased imports associated with this increased spending, but they are likely to be significant.

A7 CONCLUSIONS

Smarter Choices, if effectively rolled out across Wales, with the same level of resourcing and success as seen in English sustainable travel towns is seen to have significant economic and emissions impacts; whilst any Welsh initiative would of course be different from that in England, driven by different topographical, public transport provision and population-dispersion effects. It is likely that investment in both hard infrastructures and enabling ICT would be necessary with this not part of the English approach.

Notwithstanding, the above analysis does scale, indicatively at least, the potential environmental and economic benefits which Smarter Choices Wales, suitably funded, could lever. These amount to a net increase in gross value added of over £110m, and a net increase in FTE employment of over 2,400. Meanwhile, the analysis suggests a net reduction of 170,000 tonnes of carbon emitted in Wales.

Perhaps more illustrative and informative is the extent to which householders' behaviour can work to support or minimise both economic and emissions effects. In the scenario above, additional spending of households works to substantially increase employment in Wales but with this of course implying increased emissions. If we consider the gross carbon saving associated with reduced car journeys as 100%, increased public transport vehicle miles claw back 5.6% of this saving, whilst increased spending by households in the absence of further behaviour change claws back a further 20%. The message here then is that firstly, wider behaviour change is critical, and secondly, economic and environmental objectives can often conflict, requiring careful policy to encourage spending and hence employment in sectors and occupations which are genuinely low carbon.

APPENDIX B

THE WELSH REFURB: ECONOMIC AND CARBON POTENTIAL

B1 THE WELSH REFURB

The main section of this report outlines the Assembly Government policy action that Stop Climate Chaos Cymru believe is the necessary minimum to reduce Greenhouse Gas emissions from Welsh domestic housing consistent with a beyond-40% reduction to 2020. The proposal modelled in this Appendix is, in summary, that a third (400,000) of existing Welsh housing stock will have benefitted from a whole-house refit encompassing energy efficiency and micro-generation (where appropriate) to reduce emissions by around 60% per property. This will reduce total GHG emissions from the housing sector by 20%.

Achieving a reduction of 40% in emissions from the whole sector will necessitate the additional actions identified in section 2 of this report, namely: action on the worst performing housing across the entire country, encouragement for owners of the remaining houses to adopt significant energy efficiency measures, and decarbonisation of grid electricity through greater use of renewable energy sources.

The proposal differs from existing WAG actions in a number of ways. Firstly, it assumes a whole-house approach and is area-based, initially targeting areas of deprivation and potential fuel poverty. Secondly, it utilises the range of available measures, including insulation (loft, cavity and wall); micro generation and fuel switching. These measures are currently split between ARBED and HEES with thus different funding conditions and implementing agencies – and this is militating against a single-intervention, whole house approach. Thirdly, the level of intervention, in terms of number of properties treated, and extent of carbon reduction, is far greater than HEES and ARBED combined.

What this Appendix does not do is enter the complexity of implementation or funding alternatives. It is intended instead to illustrate firstly, the potential economic impact of Refurb in gross terms across the lifetime of the capital spend; and secondly, the potential for gross carbon savings resulting from the reduced energy use in treated properties. What this modelling does assume is that the Welsh construction sector has the scale and skill-set to largely implement Refurb without recourse to imported labour (albeit with various materials and technologies imported of course). This element is taken up in far more detail in Appendix C.

B2 AVENUES OF IMPACT

Following Refurb intervention, we posit a number of impacts relating to the economy and emissions levels:

- Refurb spending by householders, landlords, the public sector and others comprises additional demand in the Welsh economy, leading to the creation of economic gross value added and supporting and creating employment. This happens both directly, in construction and energy sectors, and indirectly along Welsh supply chains;
- Money saved on energy bills by householders and tenants is converted to additional disposable income and hence, in part, to higher spending on Welsh goods and services, again with implications for regional value added and employment;

- Reduced burning of fossil fuels (both directly by householders and indirectly in electricity generating power stations) leads to lower GHG emissions arising in Wales (here reported as CO₂e).

It is important to note that the real energy use landscape is complex. For example, for interventions such as HEES, there are elements of fuel switching as more households are connected to the gas mains, with positive impacts on fuel bills but far more uncertain impacts on GHG emissions (particularly if switching from electricity to oil or gas and we assume increasing renewables in the generation mix). Moreover, the policy landscape is complex. Governments can 'cost' carbon savings differently, dependent on whether the carbon arises from 'traded' or 'non-traded' sources, with this linking to UK commitments under the Kyoto protocol.

For the purposes of this illustrative analysis, we ignore these cost-of-carbon issues and simply try to arrive at a gross cost of implementation; regional economic impact and estimate of actual carbon reductions, without entering a debate as to whether these will result in offsetting actions in the rest of the UK as the UK government is less pressured to reach Kyoto targets.

B3 COSTING THE WELSH REFURB

It is not straightforward to estimate the gross cost of upgrading 400,000 Welsh homes to an extremely high standard of energy efficiency and installing micro-gen and/or solar heating where appropriate. Work undertaken at UK level suggests a conservative estimate of between £10,000 and £15,000 per treated property in terms of eco-interventions that deliver 60%+ energy savings^{xv}. With this possibly an underestimate for Welsh homes which are of lower energy performance compared to the UK, and of course with additional challenges linked to rurality, we take the upper estimate of £15,000 per household as our indicative figure. In addition to direct spend there are of course survey and management costs, which examination of HEES suggests may be around 15% of gross spend^{xvi}.

Even this conservative estimate of spend per property implies a large investment across Wales – approximately £7bn over the ten year period to 2020. The mechanisms whereby such investment is enabled, with this originating from across the private and public sectors, and from householders and landlords, are therefore absolutely key to success. This £7bn investment must also be seen as improving a stock of property that is currently worth perhaps £150bn^{xvii}.

Additional to the scale of spending, we must estimate the nature of that spending. Material inputs will comprise the purchase of insulation materials; heating systems; solar panels and micro-generation systems (solar PV, ground and air pumps and perhaps wind turbines). In some cases (such as for insulation) there is a well developed Welsh supply base, both existing (e.g. Knauf) and potentially in new products such as sheep's wool. The same potential exists in Solar PV with Sharp and ICP based in, but currently selling little to Wales^{xviii}. In other areas – heat pumps for example – we can expect installed systems to be imported. This assumption is, of course, very important in examining the economic impact of undertaken works.

Another element that is critical in driving regional economic impact is firstly, the extent to which Wales-based labour is used to install necessary upgrades (hence with related wages accruing to Welsh residents); and secondly (and of course related), the extent to which Welsh companies, particularly SMEs, can capture, contracts to undertake works, meaning profits accrue to Welsh companies, and of course with the construction sector as a whole safeguarded and developed as a result of Refurb.

B4 MODELLING ASSUMPTIONS

Any economic (and here environmental) modelling exercise requires reasonable inputs to achieve reasonable results. We have here examined a variety of existing published information on the nature of refurbishment in pursuit of >60% energy savings, plus published and unpublished information from the Assembly Government regarding the activities and costs associated with ARBED and HEES for existing domestic stock^{xix}. We have thus derived assumptions regarding likely cost per measure and dwelling, measures enacted (in aggregate) and thus overall costs. These costs amount to a total of **£7bn** over the ten-year period, including all labour and management costs.

Further assumptions must be made regarding the proportion of each measure enacted which comprises labour costs; the profits of companies involved; taxes and then material and technology costs. There is limited formal information available here so we have used a variety of approaches including email discussions with knowledgeable key actors to estimate the spread of inputs in the refurbishment process^{xx}. Table B1 outlines the results of this analysis.

Table B1 The Welsh Refurb

£m (2011)	Insulation	Gas	Growth Technologies	Admin, surveys etc	Total
Materials etc.	1,050	490	970	-	2,510
Labour, profits & other costs	820	510	2,170	990	4,490
Total cost of measure	1,870	1,000	3,140	990	7,000

Sources: See text

Notes:

Insulation: Cavity, roof, internal & external wall

Gas: connection to mains and new heating systems

Growth Technologies: Air & ground source pumps; solar hot water. PV not currently considered in WAG documentation.

It is important to note that we do not apply a discount rate to the costs and benefits of interventions to achieve a net present value. Whilst this is standard practice for public sector interventions, in this case the proposition that future benefits are worth less than current benefits is open to serious question. As the twin pressures of fossil fuel scarcity and climate change become increasingly severe in ways which cannot be fully captured by trend assumptions in fuel costs or carbon price, future benefits of energy investment might indeed be far more valuable than present benefits. By reporting costs and benefits in current £, we implicitly equate future and present benefits.

Not all this money will be spent in Wales. Some relevant technologies are not manufactured in Wales, and are unlikely to be in the upcoming decade. Further, exchequer taxes and income tax/NI comprise further regional leakages. We do, however, assume that the majority of labour used to install measures is Welsh, as are relevant company profits (following interventions detailed in Appendix C). This analysis suggests that of the £7bn gross spending, around **£3.9bn** might comprise regional economic impact net of all leakages and taxes (Table B2).

For simplicity we assume a 30 year effective operation period for housing interventions, although in reality savings may be delivered for longer, or technologies actually replaced again as better alternatives become available.

The £3.9bn of investment in housing stock has further implications for the Welsh economy as, to varying degrees, raw materials (such as insulation); finished products (gas piping); machinery (boilers, pumps, control systems etc.) are purchased from within Wales, and with supplying companies making further purchases of inputs from Welsh companies. Added to this is a significant addition to Welsh household disposable income of around £1.6bn arising from wages paid to those working on Refurb over the ten year period. This money too has multiplier effects, as households use additional income in part to purchase additional Welsh goods and services.

Added to this traditional economic impact assessment is the disposable income accruing to households as a result of lower fuel bills – although this will comprise lower revenues, profits and employment for utility companies operating in Wales. We estimate this would average £785 per household per year over the thirty year period following 60%+ energy savings^{xxi}. This amounts to a gross saving of over £310m per annum for Welsh households, £9.4bn over the thirty-year period^{xxii}.

Some of this saving would be lost to householders under the various pay-as-you-save financing options. Discounting the increase in income by 50% to account for PAYS thus results in a net-addition to Welsh disposable income of £4.7bn over a thirty year period, with a commensurate drop in spending on fuel, and £7bn increase on the measures detailed in B4⁶¹.

B5 THE REGIONAL ECONOMIC IMPACT OF REFURB

Following the above analysis, Table B2 outlines the regional economic and emissions impact of the suggested domestic retrofit programme. Each of the three elements described has important effects in both spheres.

The refurbishment element itself adds over £3bn to Welsh Gross Value Added (GVA) over the 2010-20 implementation period, largely comprising additional wages to Welsh workers and profits of Welsh resident companies. Allied to this increased economic activity are considerable employment effects; estimated here at almost 200,000 person-years in total, with Refurb supporting 19,880 FTE employees in each year. The economic importance of this impact is highlighted by the fact that the Welsh construction sector employed in 2007 only around 75,000 FTEs in total^{xxiii}.

This additional economic activity has, of course, implications for Welsh GHG emissions, with affected sectors (such as construction and manufacture of insulation) relatively high emitters in Wales. We estimate that in this case Refurb might add 7m tonnes of carbon emissions over the decade intervention period .

Table B2 The Welsh Refurb: Economic and Emissions Impacts

	Refurb interventions	Fuel savings	Household income	Net Impact
Gross Value Added (£m)	3,120	-2,660	2,580	3,040
Employment (person years)	198,840	-25,650	54,280	227,470
Emissions (tonnes CO2e)	7,155,500	-31,028,400	1,730,080	-22,142,820
Annualised:	2010-2020		30 Year	
GVA (£m)	310	-90	90	100
Employment (FTEs)	19,880	-860	1,810	7,580
Emissions (tonnes CO2e)	715,600	-1,034,300	57,700	-738,100

The consequential effects of Refurb include substantial reduction in fuel burned in Wales, both directly as mains or bottled gas, and indirectly to supply electricity⁶². The reduction in economic activity in energy sectors over the thirty-year period examined totals £2.66bn. This is in fact a relatively small amount compared to the £10bn reduction in gross spending on energy, because most energy spending results in imports of fossil fuel rather than supporting Welsh incomes.

Nonetheless, there is a significant negative impact, as modelled at least, on employment in energy sectors, totalling -25,650 person years of employment over the thirty year period (-860 FTEs per annum). This result should however be treated with a measure of caution. The limitations of our model results in a linear relationship between sales and employment losses. In actuality, with gas and

61 For simplicity we do not here include the impact of likely increases in fuel costs as gas and oil reserves becoming scarcer.

62 Again due to high levels of uncertainty we do not attempt to model changes in the %age of houses reliant on electricity for heating, or of changes in the generation fuel mix.

electricity infrastructure still required to the same extent, employment losses would be far less severe although it is impossible to estimate this numerically.

Avoided carbon emissions are, however, very significant following Refurb, totalling over 31m tonnes of CO2 equivalent over a thirty year period. This amounts to a reduction potential of over 1m tonnes of CO2e in Welsh emissions in every year the Refurb upgrades are functional.

It should be noted that this estimate excludes any potential rebound and comfort-taking effects. The literature suggests that usually between 20-25% of energy savings through increased efficiency are lost as householders take advantage of affordable warmth. These findings illustrate the importance of soft, attitudinal interventions along with 'hard' measures to tackle climate emissions.

The most significant economic impacts occur as Welsh households spend their increased disposable income in the regional economy. This spending adds £2.58bn to Welsh GVA over the 30 year period (£90m per annum), implying 54,280 person years of employment (1,810 FTE jobs in any one year). There are of course substantial GHG emissions associated with this extra spending; 1.7m tonnes over the thirty years; 57,700 tonnes per annum .

Summing the positive and negative impacts of these three avenues of regional impact provides an estimate of the net impact of Refurb. Over the period, the programme comprises both a significant net addition to regional economic activity (£3.04bn) and regional employment (227,470 person years of employment) whilst saving a net 22m tonnes of carbonCO2-equivalent GHG emissions (738,000 tonnes per annum).

This analysis of course assumes effectively static energy prices over upcoming decades whereas the projection is for increasing prices, certainly to 2020 if not beyond. It is therefore more likely that intervention measures might be enough for affected households to keep energy costs at roughly the same proportion of expenditure, rather than releasing any additional disposable income. In this case, the 'household income' elements of Table B2 above would not be relevant. Table B3 presents this assumption. Here, carbon savings increase to £24m tonnes in total (almost 800,000 tonnes per annum) but economic effects beyond the actual implementation of Refurb disappear. With no additional income associated with energy efficiency, rebound and comfort taking effects do not apply.

Table B3 The Welsh Refurb: Economic and Emissions Impacts (Increasing Energy Cost Assumption)

	Refurb interventions	Fuel savings	Household income	Net Impact
Gross Value Added (£m)	3,120	-2,660	-	460
Employment (person years)	198,840	-25,650	-	173,190
Emissions (tonnes CO2e)	7,155,500	-31,028,400	-	-23,872,900
Annualised:	2010-2020	30 Year		
GVA (£m)	310	-90	-	15
Employment (FTEs)	19,880	-860	-	5,770
Emissions (tonnes CO2e)	715,600	-1,034,300	-	-795,800

B6 CONCLUSION

The positive economic and environmental impact of the Refurb investment highlights the 'win-win' nature of investment in managing energy demand and prioritising efficiency improvements, rather than further investments in energy supply. However, when one realises that Wales emits 40m tonnes of CO₂-equivalent in a single year, the saving of between 22m and 24m tonnes over a thirty year period is in itself nowhere near enough.

The above result can be improved in a number of ways: by minimising the carbon-emissions impact of capital works through low-carbon capital as well as operational technology (but with the model probably over-estimating these anyway) or by lengthening the period for which the upgrades are functional. There are also significant benefits to be gained from behaviour change. The assumption here is that householders (or landlords) spend any 'fuel bill bonus' along similar lines to existing household spending. If that money is instead saved, or invested in further energy saving infrastructure (either at household or community level) the carbon savings will be greater again. Meanwhile, substantial comfort taking by households unconcerned with energy use beyond its cost implications reduces the emissions benefits of measures.

APPENDIX C

THE BENEFITS OF GREEN SKILLS TO WALES

INTRODUCTION

This section reviews (both academic and policy-related) literature relevant to the accumulation of green skills or green collar jobs within economies seeking a low carbon future, in part through household refurbishment. Its purpose is to examine the key strategic issues, economic benefits and then the tactical priorities that might attach to such a programme.

Green collar workers/jobs/skills have not yet been subject to rigorous definition⁶³ but Ehmcke et al (2009)⁶⁴ suggest two categories:

Managers, professionals and technicians who work in green organisations or who have green skills and responsibilities within other organisations that may not be considered green; and Services, clerical, sales and semi-skilled workers who work in green organisations. (p19)

The Worldwatch Institute Report (funded by the United Nations Environment Programme) defined green jobs as *'positions in agricultural, manufacturing, R&D, administrative, and service activities aimed at alleviating the myriad environmental threats faced by humanity. Specifically, but not exclusively, this includes jobs that help to protect and restore ecosystems and biodiversity, reduce energy, materials, and water consumption through high efficiency and avoidance strategies, de-carbonize the economy, and minimize or altogether avoid generation of all forms of waste and pollution'* (Worldwatch Institute, 2007)⁶⁵.

These definitions recognise that 'greening' economies will develop 'green' occupations and skills within traditional non-green sectors. For example, the construction of wind turbines crosses a number of UK Standard Industrial Classification (SIC) codes. In the future, businesses will seek to reduce their emissions, making them 'greener' but not necessarily 'green'. Meanwhile, some 'green' business (such as recyclers) may be carbon-dirty in terms of their operations. These and other definitional issues will have to be resolved before benchmarks can be derived for measuring the importance of green skills in the future.

This section focuses on the green agenda linked to household refurbishment, while acknowledging that this is only part of the picture. Hence, it is anticipated here that the target traditional sector of interest is construction and associated trades, which in large part is organised into small and sometimes ephemeral business units or trade alliances for the duration of a given project.

In Wales, while the construction industry as a whole employs up to 100,000⁶⁶ people (albeit very volatile) there are but a few large indigenous companies (Redrow and Lovell both have Welsh origins and are now pan-UK), a number of medium sized contractors and a sizeable but fragmented army of sole proprietor tradespeople.

The construction industry is also highly competitive and peripatetic (for example, the revamp of Carmarthen town centre was undertaken by Simons Group of Lincoln). A substantial chunk of the

63 <http://www.sustainabilitymatters.net.au/articles/38995-Green-jobs-in-Australia-what-are-we-talking-about->

64 Ehmcke, W.; Philipson, G.; Kold-Christensen, C. 2009. Who are the green collar workers?

Defining and identifying workers in sustainability and the environment (St. Leonards, Connection Research).

65 http://www.unep.org/labour_environment/pdfs/green-jobs-preliminary-report-18-01-08.pdf

66 <http://news.bbc.co.uk/1/hi/wales/7902199.stm>

green job bonanza^{67 68} that has been identified as inevitable across the globe (Hatfield-Dodds et al 2008) relates to the construction sector and has ramifications across all business size-bands and for a wide range of clients including Registered Social Landlords, Local Authorities and the private sector within Wales.

THE IMPORTANCE OF SKILLS TO ECONOMIC PERFORMANCE

Implicit in any effective response to the 'green' refurbishment challenge is that this heterogeneous population of construction firms and their supply chain must familiarise themselves with new skills and that these should be linked to a trusted accreditation framework. By way of background, it is important to understand the relationship between skills/training and firm performance, and the significance of firm size in this relationship. The whole-economy benefit of education and skills acquisition has been well rehearsed by successive UK governments; the most recent document being 'Education and Skills: The economic benefit'⁶⁹. The premise is that '*High quality learning is strongly linked with higher earnings, lower chances of becoming unemployed, better health and reduced crime. Furthermore, it enhances worker productivity and helps the economy remain internationally competitive*'. Haskel and Martin (1993)⁷⁰ provide econometric evidence of the positive relationship between productivity growth and the amount and effectiveness of education and training.

Hence, at the macro-economic level, the accumulation of human capital drives economic growth (Lucas, 1993), while at the micro (employee) level it contributes to sustained competitive advantage (Koch and McGrath, 1996). Growth firms must be able to accommodate change (very pertinent in this context) and workforce training has been shown to enable this (Johnson and Gubbins, 1992), while failure to train has been shown to restrict growth (Hallier and Butts, 1999). The problem is that the propensity to train tends to be associated with larger firms (Brown, Hamilton and Medoff, 1990, Cambridge Small Business research Centre, 1992). Possessing a training budget, having bespoke trainers and formally identifying training needs all increase with firm size (Sadler-Smith et al, 1998).

The conclusion is that small firms tend to be less disposed to train despite an equal if not greater need to do so. Small firms hold the view that training is costly, and its benefits are not considered to enhance performance. Small firms also have very shallow hierarchies so management training is often considered to be difficult to absorb. Training is also associated with formality which is difficult for small firms. Furthermore, inter-firm skills' poaching is a disincentive to train (Hankinson, 1994). Smaller budgets, lack of bespoke human resource staff, a poor understanding of the benefits of training all hamper its take-up in small firms. The relative costs of external training are higher in small firms, and time constraints are also more onerous.

Given the size distribution of firms in the construction sector, fore-warned is fore-armed with respect to the speed and penetration of green skills take-up, with it being likely that firm size will be an important determinant of incentives strategies (see later).

SKILLS AND SME PERFORMANCE

Explanations of the low take-up of training in SMEs are much easier to locate than evidence of relationships between SME performance and skills/training. However, a survey of 211 employers in Britain conducted by Devins and Johnson (2003) to examine the impact of a range of training

67 Hatfield-Dodds, S., G. Turner, H. Schandl and T. Doss, 2008, Growing the green collar economy: Skills and labour challenges in reducing our greenhouse emissions and national environmental footprint. Report to the Dusseldorp Skills Forum, June 2008. CSIRO Sustainable Ecosystems, Canberra.

68 http://www.unep.org/labour_environment/pdfs/green-jobs-preliminary-report-18-01-08.pdf

69 http://www.education.gov.uk/rsgateway/DB/ECO/e000998/Eco_Social_Text.pdf

70 <http://www.jstor.org/stable/pdfplus/2234777.pdf?acceptTC=true>

interventions linked to European Social Fund (ESF) Objective 4 (O4) programme (1998-2000), showed that one third of firms reported a 'big positive impact' on sales resulting from the programme, with two thirds of firms in the 25-49 size-band reporting the effect. The initiative was also linked to increasing firm competitiveness, and confidence in the future. What seems to be easier to prove is the deleterious effect of not training, with lack of skills hampering productivity growth, sales growth, innovation and investment (Hogarth and Wilson, 2001).

Also pertinent in this context is the individual benefit gained from skills acquired during a working lifetime. Several studies have suggested that improving basic skills in adult life can lead to favourable outcomes in the UK labour market (Machin et al. 2001; Bynner et al. 2001). Blundell et al. showed that training which led to a qualification, perhaps gained from a current or previous employer, can yield wage benefits. Such skills also improve promotion prospects and job security (Blundell et al. 1999). A full review of the links between skills/training and firm performance can be found in Tamkin's report 'The Contribution of Skills to Business Performance' (2005)⁷¹.

GREEN SKILLS

The greening of the developed world has prompted much enthusiasm as a force for job creation. Bezdek (2007) estimates that, over the next two decades, one in four Americans will be 'directly or indirectly employed' in a green industry. Meanwhile, White and Walsh (2008) highlight the lack of skills in the US to meet this new demand. The same skills shortages have been identified in Germany (UNEP 2008), and Australia.⁷²

There is still some debate as to whether these skills are new. New skills are identified as follows:

- Knowledge of sustainable materials
- Carbon foot-printing skills
- Environmental impact skills
- Renewable energy engineering

Mostly green skills comprise traditional skills (carpentry, electrical work etc) complemented by new skills. Household refurbishment will require traditional construction skills, supplemented by training in energy-efficiency measurement techniques, installation skills and product knowledge. Table 1 below breaks down work skills, with the bottom third describing the converging skills that will be inherent in making the most of the green bonanza.

Hence, there is a general understanding in the green skills literature that there are two separate but related challenges. The first is to ensure that there is an adequate pool of skills in the existing workforce to fill the 'new' green jobs. The second is to ensure that there is sufficient resource to meet the need for upgrading or updating existing job profiles. The priority, in the context of household refurbishment, will be on upgrading and widening the existing suite of skills within the construction trades.

71 <http://www.employment-studies.co.uk/pdflibrary/rw39.pdf>

72 <http://www.drakeintl.com/au/pdf/04%20-%20Green%20paper.pdf>

Table C1 Classification of skills at work

BASIC SKILLS	
Routine	Repetitive, more basic, low-knowledge intensive skills (e.g. packing chocolates in boxes in a factory line, making copies using a simple photocopy machine).
Sector specific	Skills required to operate non-complex machinery or non-complex activities but requiring some technical sector specific competences (e.g. metal cutting, woodwork, traditional farming and fishing).
ESSENTIAL SKILLS	
Generic	Oral communication, written communication, numeracy and literacy, general IT user skills and office administration skills. ¹³
ADVANCED / KNOWLEDGE INTENSIVE SKILLS	
Technical	Skills required for problem solving; design, operation, rethinking and maintenance of machinery or technological structures or marketing plans; ICT professional skills, research skills (e.g. work developed by engineers, researchers, marketing professionals) and drafting skills.
Management	Skills for business planning, regulations and quality control, human resources planning (recruitment, training and skills development) and allocation of resources (e.g. management of intellectual property, financial management, firm health and safety operations).
Social and communication	Motivation and appreciation of people's characteristics for individual and team working purposes; customer service; appreciation and communication through networks and value-chain partners (e.g. ability to reach consensus and agreements, ability to recognise individual's talent and team's contributions to common goals).
Multi-language and cultural	Ability to communicate in more than one language, appreciation of cultural characteristics of different ethnic groups (e.g. communication by a customer representative selling products/services in different countries, capacity to incorporate cultural differences in negotiations).
CONVERGING SKILLS	
Entrepreneurship	Specific skills required for creating and running new business ventures and innovative projects in existing firms such as risk assessment and warranting, strategic thinking, self-confidence, the ability to make the best of personal networks, motivating others to achieve a common goal, co-operate for success, and the ability to deal with other challenges and requirements met by entrepreneurs.
Green	Specific skills required to adapt products, services or operations due to climate change adjustments, requirements or regulations (e.g. water purification and site remediation planning/engineering in mining, solar panels installation, wind turbines design, green management, carbon capture and storage techniques).

Source: OECD 2010

<http://www.oecd.org/dataoecd/46/51/45484420.pdf> accessed Jan29th 2010

It has been estimated that building firms, product manufacturers and suppliers in the UK could tap into a market worth anything from £3.5bn to £6.5bn per year⁷³. Currently it is estimated that £23bn per year is spent on repair and maintenance work to existing homes⁷⁴. Clearly, there are enormous benefits to Wales if it can be an early bird in terms of preparing for the green bonanza, and even a 5% share (based on population) would suggest £175m to £325m worth of business per year. Recalling the case of training versus not training cited previously, the penalties for not being prepared would be great. A satisfactory response to the challenge will have several elements, probably best executed on a range of spatial levels and agencies, from the Assembly to key stakeholders i.e. local authorities, further education, construction client organisations such as Large Scale Registered Social Landlords, their construction company suppliers, etc at the city or town level.

Table C2 Indicative Key Elements in a Green Skills Strategy

Element	Action	Agent/Task force
Element 1	Setting realistic goals	WAG in consultation with RSLs, green stakeholders Establish potential impact of Building Regulations
Element 2	Identifying the necessary workforce skills	WAG in consultation with RSLs, green stakeholders and the construction industry inc. a sample of sole traders.
Element 3	Identifying leading local building contractors/alliances, understanding the size of the sector and the split between trades (electricians, plumbing, fitting out)	WAG, ONS Access local supplier databases.
Element 4	Evaluating the capacity of existing training programmes to be adapted and to meet demand	Colleges of Further Education, Building Federation and UK National Housing Federation, Trades Training Organisations*, RSLs, a sample of construction companies, sample of sole traders. Work with Sector Skills Specialists (ConstructionSkills) to incorporate low-carbon refurbishment into National Occupational Standards. Identifying fit with current & potential structure of post-16 education & training in Wales
Element 5	Incentivising the sector: using exemplars	Undertake refurbishment showcases/exemplars in Wales**. Involve suppliers to the Trade (builders merchants like Robert Price) for disseminating information. 'Green' iconic public buildings, and work with affordable housing new build projects which run apprenticeship schemes. Identify and promote examples of best practice at the city level and organisation level. Use Cymorth Cymru to consult and disseminate information on a low carbon standard for the social housing sector. Target well-paying construction companies with

73 <http://www.governmentsustainability.co.uk/content/view/291/3/>

74 <http://www.fmb.org.uk/news/campaigns/building-a-greener-britain/>

		<p>growth potential as flag-fliers.</p> <p>Integrate green principles into the procurement process.</p> <p>Design a Welsh green logo Kite/Trust Mark</p> <p>Develop Green Building Codes</p> <p>Provide Green Technical Support Services</p> <p>Explore Green Innovation Grants</p> <p>Encourage Green Collar Training partnerships</p> <p>Build a Centre for Sustainable Refurbishment/Green Construction College for Wales ***</p>
Element 6	Incentivising sole traders, SMEs and individuals: Accreditation Schemes and CPD	<p>Advertise up-skilling opportunities on local supplier databases.</p> <p>Explore Training Grants for SMEs to subsidise Day Release arrangements for individuals</p> <p>Day Release Training Grants for sole traders</p> <p>JobCentre Plus – Green Skills</p>
Element 7	Financing the Green Economy Preparation Process	<p>EU Grants, Local Tax, initiation of a local WAG Grant system, third sector, FITS, Green Bonds...</p>

Notes:

* <http://www.rftraining.co.uk/training-courses/>

<http://www.newcareerskills.co.uk/domestic-green-engineer-courses.htm>

<http://www.greenwisebusiness.co.uk/news/new-green-energy-training-facility-opens-in-dartford-1924.aspx>

** see Rethinking housing refurbishment & Core <http://www.rethinkinghousingrefurbishment.co.uk/page.jsp?id=1077> (last accessed Jan 27th 2011)

*** greenwise business <http://www.greenwisebusiness.co.uk/news/centre-for-sustainable-building-refurbishment-set-to-open-in-west-midlands-1590.aspx>

http://www.rethinkingrefurbishment.com/filelibrary/Publications/NRC_PDF_ReportV3OK.pdf

Table 2 identifies some policy and action themes that might be expected to run concurrently. Note that it is recognised that while the sort of skills will be similar for those who undertake new build and those that would undertake private sector refurbishment, they are separate populations that would need to be accessed through different conduits. Larger businesses are much more likely to network, lobby and have higher level contacts and then be better placed to engage in CSR, offer training, have apprenticeships, and keep abreast of legislation etc. Because of this, working with these firms is strategically important.

Back in 2000, The Green Register was set up as a not-for-profit organisation to promote sustainable building practices across all disciplines of the construction industry. It appears to be an association of like-minded professionals offering advice and best practice. In 2009, it teamed up with the Royal Institute of British Architects (RIBA) to run workshops on effective green house refurbishment, but these are aimed at professionals. The ethos of the Green Register seems to be advisory rather than prescriptive, rightly so for its time. But ten years on, gentle persuasion is less appropriate than an urgent need to convert an environmental imperative into a commercial opportunity.

Since most refurbishments would be undertaken by sole traders or micro businesses it will be particularly important (but much more difficult) to incentivise them to acquire the necessary skills (not least because of the time constraints many face). Accessing and informing such a large and diverse group would be heavy-going, and it is likely that the most effective incentives would be through these firms recognising competitive advantage from having green standards, code and credentials, in much the same way as the Gas Safe Register (formerly Corgi standard) is respected by the heating engineering trades, and understood by the householder. The Microgeneration Certification Scheme

(MCS)⁷⁵ which relates to domestic energy renewables is already in place. It is therefore of some urgency that a similar quality assurance scheme for refurbishment gains currency⁷⁶.

Slower to proliferate than in the US and Australia, there are now a number of commercial training organisations in existence (see note * to Table 2), some of which are offering green skills training. These organisations claim to offer certification which is acceptable to the industry. For example, a new facility opened in Dartford in November 2010 which intends to train thousands of workers. It is run by Able Skills Ltd (a privately owned training provider), and has the backing of Mitsubishi Electric UK, Poly Pipe, Domus and Heating Plumbing Supplies (HPS). Its renewable energy courses are accredited by City & Guilds, BPEC, and NICEIC, which are a requirement in order to become MCS registered. More courses are to be added in 2011. The trade merchant partner HPS is offering the purchase of courses through its trade accounts.

The UK is proving to be slow on this and Wales similarly slow, despite some pathfinder facilities such as the Centre for Alternative Technology and the British Gas Green Skills Training Centre in Tredegar.

75 <http://www.microgenerationcertification.org/installers/certification-bodies>

76 http://www.existinghomesalliance.org/media/dec_2010/Key%20policies%20for%20accelerating%20retrofit_Existing%20Homes%20Alliance%20Dec%202010.pdf

ADDITIONAL REFERENCES

Bezdek (2007) Renewable Energy and Energy Efficiency: Economic Drivers for the 21st Century.
<http://www.greenforall.org/resources/renewable-energy-and-energy-efficiency-economic>

White S and Walsh J (2008) Greener Pathways: Jobs and Workforce Development in the clean energy economy' Center on Wisconsin Strategy

Hatfield-Dodds, S., G. Turner, H. Schandl and T. Doss, 2008, Growing the green collar economy: Skills and labour challenges in reducing our greenhouse emissions and national environmental footprint. Report to the Dusseldorf Skills Forum, June 2008. CSIRO Sustainable Ecosystems, Canberra.

Brown, C. Hamilton, J. and Medoff, J. (1990) Employees Large and Small, Harvard University Press, Cambridge, Mass.

Cambridge Small Business Research Study (1992) The State of British Enterprise Department of Applied Economics, University of Cambridge.

Hallier, J. and Butts, S. (1999) Employers' Discovery of Training: Self Development, Employability and the Rhetoric of Partnership' Employee Relations, Vol 21, Issue 1.

Hankinson, A., (1994) Small Firms' Training: The Reluctance prevails, Industrial and Commercial Training Vol. 26. No. 9 pp 28-30 MCB University Press.

Johnson, S., and Gubbins, A. (1992) Training in Small and medium-sized Enterprises: Lessons from North Yorkshire in K. Chell, E. Chittenden, and F. Mason, C, (Eds) (1992) Small Enterprise Development: Policy and Practice in Action, Paul Chapman, London.

Koch, M. J. and McGrath R. G. (1996) Improving Labour Productivity: Human Resource Management Policies Do Matter Strategic Management Journal 7: 332 54.

Lucas, R. E. (1993) 'Making a Miracle' Econometrica 61 (2) pp 251-72.

Sadler-Smith, E., Sargeant A, and Dawson, A. (1998) Higher Level Skills Training and SMEs in International Small Business Journal 16, 2, Issue 62.

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- i <http://www.dft.gov.uk/pgr/sustainable/demonstrationtowns/>
 - ii www.weru.org.uk
 - iii <http://www.dft.gov.uk/pgr/statistics/datatablespublications/railways/>
 - iv <http://www.dft.gov.uk/pgr/statistics/datatablespublications/public/bus/>
 - v <http://wales.gov.uk/docs/statistics/2009/091027wts2009ch6ency.pdf>
 - vi See <http://www.dft.gov.uk/pgr/statistics/datatablespublications/public/bus/#technical>
 - vii <http://www.arrivatrainswales.co.uk/OurCompany/> plus published accounts.
 - viii http://www.atoc.org/clientfiles/File/publicationsdocuments/nps6E1F_tmp.pdf
 - ix See Input-Output Analysis: Foundations and Extensions, 2nd Edition Ronald E. Miller & Peter D. Blair Cambridge University Press ISBN: 9780521517133
 - x www.defra.gov.uk/environment/business/.../passenger-transport.pdf
 - xi http://www.airquality.co.uk/archive/reports/cat07/0909240909_DAGHGI_1990-2007_Issue_1.xls
 - xii See <http://www.abd.org.uk/taxtable.htm> plus <http://news.bbc.co.uk/1/hi/8598369.stm> and [Whatprice.co.uk](http://www.whatprice.co.uk)
 - xiii www.statistics.gov.uk/abi
 - xiv *ibid*
 - xv Killip, G (2008) Building a Greener Britain: Transforming the UK's Existing Housing Stock Environmental Change Institute, University of Oxford A report for the Federation of Master Builders
 - xvi <http://www.heeswales.co.uk/stakeholder-info.htm> plus unpublished WAG reports.
 - xvii September 2010. <http://www.landregistry.gov.uk/houseprices>
 - xviii http://www.wof.org.uk/home.php?page_id=58

- xix *ibid*; <http://wales.gov.uk/topics/environmentcountryside/energy/efficiency/arbcd>
- xx We are grateful here to staff from WAG; Wales Sustainability Reinvestment Trust; Rounded Developments. Also see www.greenbuildforum.co.uk
- xxi Fuel prices assumed to average 5.5p p/Kwh across Gas and Electric (90% gas weighting) with average savings at 14,260 Kwh per annum. See http://www.decc.gov.uk/en/content/cms/statistics/regional/high_level/high_level.aspx <http://www.guardian.co.uk/business/2010/feb/03/ofgem-uk-energy-supplies>; plus unpublished HEES data.
- xxii The peaking of oil and gas supply during this period will of course very likely result in far more substantial increases in energy prices than those modeled here, resulting in far greater savings; www.brass.cf.ac.uk/uploads/Wales_in_the_Energy_Crunch.pdf
- xxiii www.weru.org.uk
- xxiv This carbon estimate may in fact be rather too high. For example, within the EE-IO model insulation sits in the non-metallic minerals sector, whose carbon intensity is made far higher by cement production.
- xxv This household analysis assumes additional household spending follows already-established patterns
- xxvi *ibid*