

An Index of Sustainable Economic Welfare for Wales: 1990-2000

Report for the Countryside Council for Wales

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Executive Summary: An ISEW for Wales: 1990-2000

ISEW - Introduction

The objective of this research was to develop an index of sustainable economic welfare (ISEW) for Wales for the period 1990-2000, and to explore its policy value in the context of the Welsh Assembly Government's (WAG) headline indicators of sustainable development, and more general aggregate sustainability indicators.

The ISEW represents an attempt to measure the underlying factors that create real progress. The ISEW has as its base personal consumption spending, then a series of adjustments are made to consumption to arrive at the index value for a given year. An ISEW is one amongst a series of aggregate indicators of sustainability. ISEW has potential value if used with other indicators to inform debate and stimulate questions about the nature of the development process. This report demonstrates that there would be clear value in adding the ISEW to the WAG headline sustainable development indicators.

ISEW has the following advantages as an indicator:

- social and welfare aspects of sustainable development are incorporated;
- distribution of resources in a society, transactions outside the market process adding to welfare, and usage of natural capital are considered;
- the index provides an indication of the net benefits to society of its production and consumption;
- Finally, ISEW provides a time-series measure that captures, in one indicator, the main elements that together contribute to quality of life in Wales.

ISEW in Summary Form

$$\text{ISEW} = C_{\text{adj}} + P + G + W - D - E - N$$

Where

C_{adj} = consumer spending adjusted for income inequality

D = defensive private expenditures

P = non-defensive public expenditures

E = costs of environmental degradation

G = growth in capital and net change in international position

N = depreciation of environmental capital base

W = non-monetarised contributions to welfare

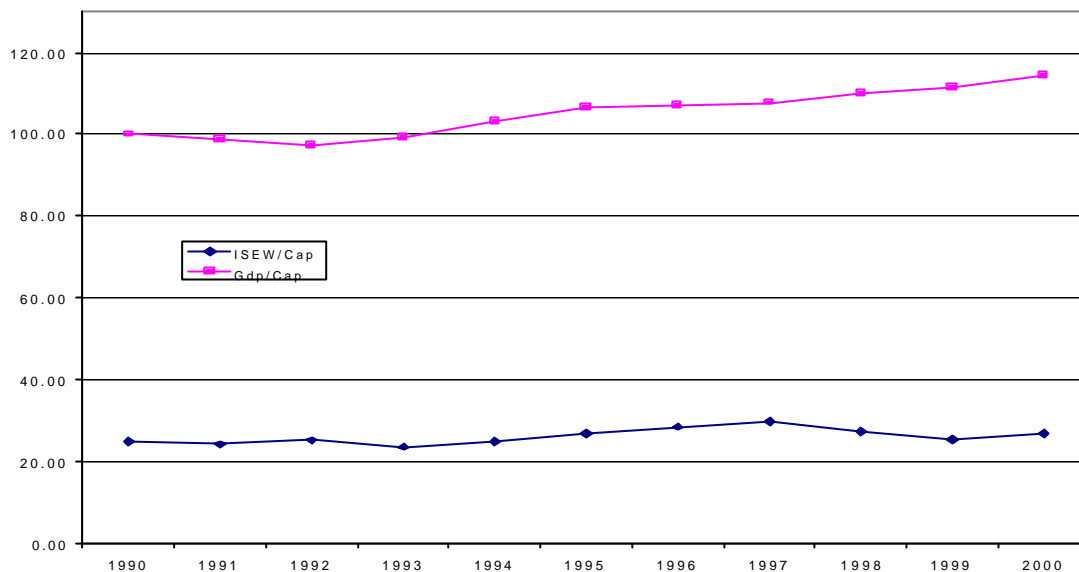
ISEW for Wales 1990-2000

The value of the ISEW (see Table 1 below) was £6.05bn in 1990 – between 1993 and 1997 the ISEW increased in value to £7.3bn. During 1998 and 1999 the ISEW value fell before increasing in 2000. By 2000 the value of the ISEW was 9.1% higher than it had been in 1990. The value of the ISEW was typically within a range of 23-28% of GDP between 1990 and 2000. In 1990 the ISEW per capita stood at £2,100, and increased to £2,241 by 2000. This compares with GDP per capita values for 1990 and 2000 of £8,359 and £9,553 respectively. Figure 1 provides an index for GDP and ISEW per capita. This shows that in the late 1990s the ISEW fell, whilst the trend in GDP per capita has continued steadily upwards. ISEW per capita was 6.7% higher in 2000 compared to 1990. Over the same period GDP per capita increased by 14.3%.

Table 1 Values for GDP, ISEW, and in per capita terms

Year	GDP (£m 1995)	ISEW (£m 1995)	GDP/capita (£ 1995)	ISEW/capita (£ 1995)
1990	24085.11	6050.53	8358.82	2099.86
1991	23872.51	5850.14	8270.69	2026.79
1992	23591.68	6114.71	8139.27	2109.61
1993	24107.07	5756.59	8294.19	1980.59
1994	25090.26	6046.56	8613.20	2075.72
1995	25989.00	6528.29	8910.11	2238.17
1996	26153.92	6977.68	8953.45	2388.72
1997	26374.76	7297.53	9011.78	2493.43
1998	27002.74	6730.56	9206.53	2294.77
1999	27376.45	6239.73	9321.23	2124.53
2000	28142.99	6603.10	9552.95	2241.38

Figure 1: GDP and ISEW per Capita (1990 GDP per capita = 100)



ISEW and Policy Development in Wales

Currently a number of approaches are being developed in Wales to monitor progress towards sustainable development objectives. The WAG has published its own set of sustainability indicators for Wales. These headline indicators are diverse including mix of statistics including employment activity, educational attainment, crime rates, housing (unfit dwellings), climate change (greenhouse gas emissions), air and water quality, wildlife population, waste recycled, Welsh language use, electricity production from renewables, and ecological footprint values. Whilst these indicators will provide valuable information, they are in mixed units of account (e.g. physical volumes, employment, and money values), and hence cannot provide a picture of sustainability and welfare trends.

The ISEW combines economic, environmental and social factors into one overall measure of real welfare. An ISEW enables a better understanding of what the conventional approaches purport to measure and their weaknesses. Such a measure enables an understanding of the expected components of welfare gains in Wales, and more importantly the costs associated with economic development.

WAG still has a relatively limited suite of information on which to assess progress towards sustainable economic development. Hence assessing progress on the extent to which the Assembly has made progress towards its statutory obligation on sustainability is difficult. The developed ISEW is one valuable addition to a much larger suite of information that would be required to make a more thorough assessment. The ISEW can assist policymakers to ask appropriate questions, and make more informed judgements.

If current patterns of consumption and activity are maintained in Wales there is every indication that the gap between the ISEW and GDP will increase. The nature of the relationship between GDP and ISEW could then be the context of broad policy objectives. Policy could focus on closing the gap between the GDP trend and the ISEW trend. This would then require a policy objective committing WAG to securing year on year a more than proportionate increase in the value of ISEW compared with the proportionate increase in GDP. However, simply expressing policy objectives in terms of 'closing the gap' is imprecise – such an objective could be achieved within a period of falling GDP, which is clearly undesirable in terms of achieving the economic objectives of sustainable development.

WAG may have limited abilities to influence some of the component trends. However, in others, regional government choices can have an important bearing – examples include:

ISEW highlights the significance of attaining a higher degree of regional income equality. Elements of Assembly policy are already addressing this problem indirectly, for example, through initiatives to improve activity rates, assist disadvantaged areas within Wales, and through promoting equality in the workplace. ISEW demonstrates that improving the distribution of income can be linked through to gains in welfare.

Development of several elements in the ISEW can potentially be related to planning processes and decisions including costs associated with air and noise pollution, as well as costs associated with loss of farmland, and habitat.

Cost of commuting and car accidents where trends can be influenced by encouragement of different patterns of commuting, enhanced road safety measures, and improvements to public transport infrastructure.

Improving education on the nature of sustainable economic development, and the costs of economic development.

To conclude, ISEW is a valuable means of monitoring trends in sustainability and welfare in Wales. If this approach is combined with other indicators, then it is possible that the Assembly's progress towards its sustainability duty can be more accurately assessed.

1. Introduction

1.1. Project background

Pilot research to develop an Index of Sustainable Economic Welfare for Wales was undertaken by Midmore et al., (2000). This research estimated an index for Wales for the period 1970-1996. Linked to this initial research the Countryside Council for Wales commissioned a study from Aberystwyth and Cardiff Universities that sought to examine the practicalities of further developments to the ISEW for Wales (Stage 1 – *Developing an index of sustainable economic welfare for Wales*, CCW, 2002). This detailed study had the objectives of:

- Reviewing alternative indicators of regional economic progress, and placing ISEW within this suite of indicators.
- Examining the specific regional and national data problems connected to the construction of a Welsh ISEW, and assessing how far these could be practically and effectively overcome.
- Exploring the views of selected user communities on how far an ISEW would be practically useful in the context of other developing evaluative frameworks in Wales.

The first stage of the research concluded that development of an ISEW for Wales would be valuable and made several points including;

- That development and more extensive dissemination of the results from both the pilot research work, and any new development, could play a valuable role in making both the policy community, industry and population more aware of those factors that add to, and subtract from welfare. In this way a developed ISEW for Wales could have a role in promoting debate and understanding of the nature and limitations of a wider set of economic and social indicators.
- That there was value in individual components of the Welsh ISEW with, for example, research providing information on income distribution, services deriving from domestic labour, and levels of negative externalities from Welsh industry having a wider relevance.
- That in researching the methodological and data problems underlying an ISEW an institution such as the Welsh Assembly Government would be engaging in an innovative process and underlining its commitment to investigate a wider range of progress measures. Several recommendations were made in the report relating to the construction of a new ISEW, and to the ISEW components on which research resources might be focused. The first study suggested that short term actions might include:
 - Developing a revised index (ISEW) for Wales incorporating the best available current data and methods.
 - Developing a means of publicising/disseminating this revised index.

1.2. Research objectives

The action points from Stage 1 of the research form the basis for the objectives of Stage 2 i.e.

- To develop an index (ISEW) for the period 1990-2000 building upon the findings of Stage 1 of the research, and seeking to move, where possible, to a greater number of regional rather than national estimates for adjustments with appropriate supporting technical notes.
- To compare ISEW with other aggregate sustainability indicators and assessing its comparative value to policymakers and others.
- To provide an analysis of trends in the developed ISEW for Wales, and examining trends in individual index components.
- To recommend a strategy for publicising/disseminating this revised index.

1.3. Method in outline

In undertaking this research the main method comprised desktop research to create a suite of data to inform the construction of an ISEW for the period 1990-2000.

Data collection and analysis was informed by the conclusions from Section 4 of the Stage 1 report, which had specifically investigated for each index component: a rationale for inclusion in the index; a description of the ideal data to inform the adjustment; an examination of current data available to inform the adjustment and where appropriate an exploration of how the gap between 'current' and 'ideal' data might be bridged in the Welsh case.

1.4. The structure of this report

The remainder of this report is structured as follows. The second section provides a brief overview of the development and nature of the ISEW. The section compares the ISEW approach with current Welsh Assembly Government sustainability indicators, and then other alternative aggregate indicators that seek to reveal progress towards meeting sustainable development objectives. The review focuses on the usefulness of an ISEW within a suite of tools, methodologies/measures including ecological foot-printing, green national accounts (green net national product), and environmental satellite accounts (ESA). The third section outlines the individual components in the developed ISEW for Wales for 1990-2000. There is a brief description of each index component and its trend in the period 1990-2000. The technical details underlying the estimation of each index component are placed in the Appendix to this report. The fourth section describes the overall ISEW, and trends in the Welsh ISEW are analysed and explained. The fifth section describes some of the policy implications arising from the analysis of trends in the developed ISEW. The final section concludes and highlights the main findings from the analysis, and includes recommendations for dissemination.

2. Revisiting the Index of Sustainable Economic Welfare

2.1. Introduction

This section of the report outlines the evolution of the ISEW, and describes the nature of index components. The section compares the ISEW approach with current Welsh Assembly Government sustainability indicators. The section then compares ISEW with other alternative aggregate indicators that reveal progress towards meeting sustainable development objectives, highlighting what different approaches can and cannot do in terms of providing information and guidance to decision makers. A more detailed analysis of the development of the ISEW approach, a review of international and UK studies that have developed indices of sustainable economic welfare, and a critique of the strengths and weaknesses of the ISEW are found in the Stage 1 report to CCW *Developing an Index of Sustainable Economic Welfare in Wales*.

2.2. The Index of Sustainable Economic Welfare

The development of an ISEW by Daly and Cobb (1989) built upon several critiques of conventional approaches to monitoring economic progress (see boxed section below) and increases (decreases) in real welfare. The ISEW represents an attempt to measure the underlying factors that create real progress. Below, the approach taken to the construction of the UK index by Jackson et al. (1997) is outlined. This approach informed the construction of the pilot Welsh index by Midmore et al., (2000), and the construction of the index presented in this report.

Gross domestic product – a measure of welfare?

Growth in GDP (and GDP per capita) is one indicator of the strength of the regional economy. However, how far do increases in real GDP accurately reflect improvements in welfare? Headline GDP growth takes no account of the costs of growth, often in terms of environmental degradation, use of irreplaceable resources, pollution, and social externalities. Also reported measures tell us little about the distribution of resources in society, or the nature of activities which add to welfare but are outwith the market system, for example, the value of household labour services.

The ISEW has as its base personal consumption spending. A series of adjustments are then made to consumption to arrive at the index value for a given year including:

- A deduction for income inequality in society. Effectively such an adjustment implies that society could get similar levels of welfare from a lower level of more equally distributed income.
- An addition to take into account the value of domestic labour services.
- Adjustment to take account of the fact that an element of education and health spending does not add to welfare, for example, spending to cure people of smoking-related diseases is 'defensive' because it is remedying the negative effects of other spending.
- An adjustment to take into account that some consumer spending is on durable items from which services are derived outside of the accounting year. The adjustment adds

the value of services given by a stock of consumer durables in the accounting period, and then takes away expenditure on consumer durables in the period.

- Deductions for the costs associated with air pollution. This adjustment is comprised of estimates of the costs of economic activity in terms of damage per tonne of given atmospheric pollutants.
- An adjustment for the use of non-renewable fossil resources – i.e. depletion of environmental capital.
- An adjustment to correct for damage to future generations caused by climate change and depletion of ozone in the upper atmosphere.
- Adjustments to take account of costs connected with commuting, personal pollution control, car accidents, noise and water pollution, loss of habitat and farmlands. Also adjustments to account for net capital growth and change in net international position. The latter takes into account the source of investment capital presupposing that inward investment reliance could reflect weaknesses in the viability of the national economy¹.

ISEW in Summary Form

$$\text{ISEW} = C_{\text{adi}} + P + G + W - D - E - N$$

Where

- C_{adi} = consumer spending adjusted for income inequality
- P = non-defensive public expenditures
- G = growth in capital and net change in international position
- W = non-monetarised contributions to welfare
- D = defensive private expenditures
- E = costs of environmental degradation
- N = depreciation of environmental capital base

2.3. ISEW and the Welsh Assembly Government headline indicators of SD

The Welsh Assembly Government has published its own set of sustainability indicators for Wales. The WAG's six objectives of sustainable development in Wales are set out in its Scheme for Sustainable Development (WAG, 2002):

1. The environment being cherished and protected so that it remains healthy and biologically diverse, and can continue to support us all.
2. A self-sustaining economy which respects the environmental and social context of Wales and responds to sustainable development opportunities.
3. Action to make our communities strong and viable, and people healthier.
4. People being enabled to play a part in taking decisions that affect them.
5. Recognising the needs of all parts of Wales.
6. Wales contributing to sustainable development at a global level as well as a local.

The headline sustainability indices comprise indicators of employment activity, educational attainment, crime rates, housing (unfit dwellings), climate change (greenhouse gas emissions), air and water quality, wildlife population, waste recycled, Welsh language, electricity production from renewables, and ecological footprint values (Table 2.1). The Welsh Assembly headline indicators comprise of a very diverse mix of statistics. Whilst

¹ Due to data difficulties this final adjustment was excluded from the pilot ISEW, and is also excluded from this report.

these monitoring indicators are useful, one problem is that they are in mixed units of account, and then fail to deliver any overall picture of sustainability and welfare trends (the ecological footprint measure excepted). It is also difficult to link the indicators to the six objectives outlined above.

The development of the individual headline indicators represents an incremental step. However, the trend line in the ISEW (see later) might usefully be considered as a further headline aggregate indicator. The ISEW contains adjustments to account for air and water quality, climate change and use of non-renewables (in monetary units), each of which are included in the Welsh Assembly headline indicators (Table 2.1).

Table 2.1. Welsh Assembly Government headline indicators

WAG headline indicator of SD – issue	Indicator description	Links to the ISEW
Employment	% of people of working age in work	Some of the positive welfare effects of employment will be captured in the “consumption” component of ISEW.
Education	% of people age 19 with NVQ level 2 or equivalent	No explicit links, although the ISEW includes that proportion of education spend that is deemed to add to welfare.
Crime	Crime rates per 100,000 population: <ul style="list-style-type: none"> • Theft of or from vehicles • Burglary • Violent crime 	Not explicitly linked to any ISEW adjustment
Housing	% of unfit dwellings	Not explicitly linked to any ISEW adjustment
Climate Change	Emissions of greenhouse gases (mt carbon equivalent)	Link to ISEW adjustment that deals with costs of climate change.
Air Quality	Days when air pollution is moderate or higher: <ul style="list-style-type: none"> Urban: <ul style="list-style-type: none"> • Cardiff • Swansea • Port Talbot Rural: <ul style="list-style-type: none"> • Aston Hill • Narberth 	Link to ISEW adjustment that deals with costs of air pollution and cost connected with depletion of the ozone layer.
River water quality	% of river lengths of good or fair quality: <ul style="list-style-type: none"> • chemical quality • biological quality 	Link to ISEW adjustment which deals with the costs associated with water pollution.
Wildlife	% of widespread breeding bird species that have increased significantly since 1994	Link to ISEW adjustments relating to costs of loss of natural habitat and loss of farmlands.
Waste	Household waste & amount recycled or composted (kg/person/year): <ul style="list-style-type: none"> • total household waste • household waste recycled or composted 	Not explicitly examined in the ISEW.
Welsh language	% of people who can speak Welsh: <ul style="list-style-type: none"> • aged 3 or over • children aged 3-14 	Not included
Electricity from renewables	% of electricity produced in Wales generated from renewable sources	Not included in ISEW but linked to adjustment that deals with costs of using non-renewable resources, and costs associated with climate change caused by pollutants.
Ecological footprint	Wales’s global ecological footprint in area units per person	Not included, but some links between the EF and ISEW methods see section 2.4.

2.4. ISEW and Other Aggregate ‘Sustainability’ Indicators/Approaches

This section reports on the potential use of ISEW in comparison to other aggregate approaches which have the potential to provide decision makers with information on trends

in sustainability. The discussion here is limited to Ecological Footprint Analysis (EFA), Green National Accounts (Green Net National Product - gNNP), Index of Multiple Deprivation (IMD) and Environmental Satellite Accounts (ESA). Each of these approaches is briefly described in Table 2.2. The approaches discussed in this section can then be separated into 2 broad groups:

- those that have been already developed to some extent in Wales (EFA, ISEW, IMD); and
- those that may be developed in Wales in the future (gNNP, ESA).

Table 2.2. Aggregate Indicators of Sustainability

Aggregate Sustainability Indicators	Brief Description
Green net national product (Hartwick, 1990)	Environmentally adjusted national accounts demonstrating amount that can be consumed in a period without reducing future consumption opportunities. Approach attempts to incorporate measures for the depreciation of environmental capital.
Ecological footprint (see e.g. Best Foot Forward, 2000)	Approach compares human demands in one region with extent to which those demands might be met by the land area of the region. Consumption demands expressed in terms of land areas required to produce goods.
Environmental satellite accounts (see <i>UK Environmental Accounts 2001</i> , published as Part 5 of the Blue Book, 2001).	Components of the UK ESA include: <ul style="list-style-type: none"> • Natural resources (estimated recoverable oil and gas reserves and the monetary value of the reserves etc.) • Energy consumption by sector • Atmospheric emissions and waste • Material flows (domestic extraction, imports and exports of biomass, minerals and fossil fuels) • Revenues generated from environmental taxes and expenditure on environmental protection. In the UK ESAs have been used to inform sustainable development policy, to model the impacts of fiscal or monetary changes and to evaluate the environmental performance of industries.
Index of Multiple Deprivation (The IMD for Wales was produced during August 2000 by the University of Oxford's Department of Social Policy and Social Work for the National Assembly).	The (IMD) does not set out explicitly to consider sustainability but was designed to augment conventional economic indices, and provide a wider platform from which to explore welfare questions. The index comprised six separate 'domains' (income, employment, education and skills, housing, health and access to services) which were used to establish indices of spatial deprivation.

Each of the approaches in Table 2.2 can be compared with the ISEW against a series of broad criteria (boxed section below) which are used to explore the expected usefulness of the approaches to policy makers and a wider constituency. This comparison is summarised in Table 2.3.

The first row of Table 2.3 outlines the remit of each measure. Of all the measures selected, only the ISEW incorporates social and welfare aspects of sustainable development. Unlike more conventional (and indeed alternative) measures of progress, ISEW considers the distribution of resources in a society, transactions outside the market process adding to welfare, and takes account of the usage of natural capital. The ISEW is also useful for monitoring longer term underlying changes in real welfare. However, there can be difficulties in interpreting trends, and in understanding the monetary values attached to particular components of the index. A particular criticism of ISEW has been the degree of assumption and subjectivity involved in the estimation of components, and the

sensitivity of the overall index value to changes in particular values (such as the adjustment for income inequality). There is also no recognised international standard for constructing an ISEW. There are, however, some data commonalities with other approaches. Hence, estimation of an ISEW could provide useful inputs into other measures, generating some economies of scope. For example, the estimation of the depreciation of natural capital within ISEW could inform part of the gNNP calculation. ISEW can inform policymakers and the general public of the factors that add to, and subtract from welfare. In this way ISEW could be a valuable educational tool.

How useful are alternative approaches? Some criteria

- A. What do the approaches/concepts actually measure? While sustainability has been promoted as a legal duty in Wales there has been little consideration of what sustainability means (although it is noted that institutions such as the Environment Agency and CCW have done significant work in this respect).
- B. Could the outputs from the alternative approaches be useful in a policy framework? Public resources have been committed to approaches but with limited attention given to the usefulness of outputs. Therefore under this heading there are several issues:
- i. could the approaches show whether Wales is developing in a sustainable way?
 - ii. could the outputs be used in practice i.e. are the outputs understandable and transparent and more specifically?
 - iii. could they assist regional government to monitor progress towards sustainability objectives in agencies for which they are responsible?
 - iv. could the outputs provide useful inputs to the planning process and to develop planning guidelines?
 - v. could the outputs be incorporated into the evaluation of key policy instruments (for example, European structural funds)?
- C. What are the developmental costs and how practical is the construction method? Some approaches described could be expensive to implement. However, it is likely that some approaches are inter-linked methodologically such that economies may be available in areas such as data collection. Therefore under this heading is:
- i. developmental cost and
 - ii. scope for economies in development.
- D. How useful would the approaches be to a wider constituency (i.e. the public, firms, other groups)? Approaches may have additional value if they can be used and understood by other stakeholders. For example, in the Welsh case, the Assembly has promoted the 'sustainability agenda' amongst communities and firms, attempting to involve a wider constituency in debate and actions. The usefulness of approaches to a wider constituency is expected to be linked to Bii. above, particularly the transparency of approaches.

Table 2.3 : Approaches to monitoring and measuring sustainable development

	ISEW	EFA	IMD	gNNP	ESA
A Measurement	Combines economic, environmental and social factors into overall broad measure of real welfare.	Approach compares human demands in one region with extent to which those demands might be met by the land area of the region. Measures environmental pressure.	Index comprises six separate 'domains' (income, employment, education and skills, housing, health and access to services) which were used to establish indices of deprivation – based on published sources.	Approach attempts to adjust economic measures (national accounts) to incorporate (monetarised) measures for the depreciation of environmental capital.	The environmental impacts associated with economic activity and the importance of natural resources to the economy. Largely measures physical volumes of environmental inputs or outputs.
B i) Showing whether Wales is developing sustainably?	Partly at the headline indicator level although some problems interpreting the headline in context of movement of individual index components.	Partially, particularly if time series available.	Partially – not prime objective of this index, but could be used to investigate welfare implications of development.	Partially - although assumes that man made capital can substitute for natural capital (weak sustainability).	Partly (in terms of environment) – describes 'what is' in relation to level of economic activity.
B ii) Could the outputs be used in practice and transparency?	Possible to compare headline ISEW with headline GDP, but little evidence that this method has been used to inform policy and planning elsewhere. Headline figure can be difficult to interpret (a mix of environmental and quality of life components).	Little evidence of use to date, but useful for raising awareness of issues. Method is very detailed and complex but the final output is understandable. Large series of algorithms underpin calculation of earth share.	Yes – has been used to identify electoral divisions in Wales with largest economic and social problems, and some evidence that this has informed policy process in Wales.	Possibly – as they can be tied to national/regional accounting frameworks. Underlying growth rate of gNNP is fairly transparent (links to national accounts), but estimation difficult.	Yes – does/can inform policy at UK level. Transparent – particularly those elements of the account that are summarised in terms of physical quantities rather than monetary values.
B iii) Could outputs be used in agency monitoring?	No - it is more of a long term trend aggregate indicator.	Difficult to identify EF of institutions, but method does allow the identification of behaviours and activities that contribute to EF. Footprint may also be used to assess progress through time.	No- and not really designed for this, although results from separate domains may be of use in this respect.	No – it is an aggregate economy wide indicator used to assess long run trends.	In part – particularly the link to sectoral impacts in terms of production of pollutants, and carbon use.
B iv) Use to inform planning process and guidelines?	Yes – trend in individual components may provide information for guidelines e.g. use of land for building, and traffic regulation.	Partially as above – potential to explain link between activities and behaviours that drive EF.	Yes – may be used in decisions on where to direct resources in terms of worst off communities.	No - provides little useful information for the planning process.	Yes - e.g. sectoral planning, waste strategies etc.
B v) Use to assist evaluation of policy etc.	More useful for identifying long term trends rather than a short run evaluation measure.	This would be very difficult - possibly more useful in design of instruments and planning rather than evaluation.	Yes-time series of information on given domains could inform evaluation for example, impact of welfare policies.	More of a target than evaluation device.	Yes - useful sectoral information that could provide inputs into evaluation.
C i) Developmental costs and construction practicalities	At regional level cost can be minimised by drawing inference from existing national data sets. Specific regional data on some components would be expensive to procure e.g. surveys of incomes, household activity and consumer durables stock.	High – extensive primary element and data intensity even for small area studies.	Index has been constructed for Wales, and is not methodologically difficult to construct. Also has been constructed for other areas.	Problems of GNP at regional level – but much economic data on which to base estimates are readily available at national level.	Expensive – but much of the data used in the construction of national level accounts is collected by agencies as a matter of course, however there may be high costs in obtaining some regional data.
C ii) Scope for economies in development	Individual index components may assist with calculation of gNNP.	Some data used to construct EF could be used in ISEW and ESA.	Development of IMD has few spillovers to other approaches in this table.	Data links to ISEW and ESA.	Input into ISEW.
D Useful to a wider constituency	Headline trend may be useful, but the actual index value for any given year less transparent.	Yes – final output useful and transparent to firms and public.	Transparent inasmuch as shows best off and worst off areas across understandable domains.	Concept may be relatively well understood by wider constituency due to national accounts link.	Yes –easy to understand some individual elements of accounts.

The **EFA** measure has been accepted by the Welsh Assembly as part of its 'group' of individual headline indicators to help measure and monitor progress on various aspects of sustainable development. As with ISEW, despite the extensive level of data and analysis involved in the construction of an EF, this measure has not, as yet, featured significantly in the policy/planning/monitoring frameworks of government agencies in the UK or elsewhere. There are many similarities between EFA and the ISEW. Firstly, both methodologies are data intensive, with some of the source information more readily available than others. Secondly, the underlying data which forms part of the final estimate is of much interest in itself. In particular, if key variables can be identified as critical influences on the regional footprint, strategies could be developed to reduce this footprint. However, it is important to recognise that EFA comprises the 'cost' elements of consumption, whereas the ISEW also considers the net effects of consumption.

The **IMD** highlights trends in welfare. The value of the approach in Wales has been to assess areas of need at a very tight spatial level across several domains. The approach is also transparent and practically easier to carry out than other approaches in Table 2.3. However, there is little common ground between IMD and the other approaches.

Whilst **gNNP** is a well developed theoretical concept, estimation of this measure for the UK is still in the pilot proposal phase, with no indication that this measure will be calculated for most UK regions in the near future. There are a number of practical difficulties involved in the estimation of gNNP, particularly at the regional level, where even GDP estimation is challenging because of poor sample data. This measure would, however, provide, an aggregate economy-wide indicator that could enable the policy maker to assess long-run trends, although its use within an evaluation framework would be severely limited. The connection with the system of national (and regional) accounts is an advantage as these accounts are relatively well understood by a wider constituency (although only in very broad terms). However, this is also a disadvantage as many of the standard criticisms of GDP would also still apply to gNNP. Finally gNNP, as ISEW, features a 'weak sustainability' perspective, although in the case of the ISEW, it does in its compilation include physical data on environmental degradation.

The **ESA** approach, whilst limited to environmental factors (i.e. excluding social and welfare elements of sustainability), and largely to physical inputs and outputs provides the least controversial approach to measuring and monitoring sustainable development. Whilst these accounts (and the other approaches outlined) cannot present decision rules (as no overall/composite values can be attained) this method can link environmental factors to economic activity, with many components of the account presented at the sectoral level (e.g. pollution coefficients). The ESA is currently used to inform policy at a national level (for example, as an input to the carbon tax debate, and for planning guidelines). Table 2.3 suggests that the ESA approach, if adopted at the regional level, could be used as an aid to regional strategies. For example, information on waste arisings could inform regional waste strategies, whilst the land cover accounts could directly aid in the development of planning guidelines.

2.5. Conclusions

In conclusion, it is important to recognise that the developed ISEW is one amongst a series of potential indicators of sustainability. Its strengths in summarising long term trends in real welfare, are coupled to a number of weaknesses. Aggregate indicators such as ISEW have potential value if they are used with others indicators to inform debate and stimulate questions about the nature of the development process.

In summary, ISEW has the following advantages over other aggregate indicators of sustainability:

- ISEW attempts to incorporate social and welfare aspects of sustainable development.
- Unlike more conventional (and indeed alternative) measures of progress, ISEW considers the distribution of resources in a society, transactions outside the market process adding to welfare, and takes account of the usage of natural capital.
- ISEW provides an indication of the net benefits to society of its production and consumption.
- ISEW provides a time-series measure that captures in one indicator the main elements that together contribute to quality of life in Wales.

3. The ISEW Components 1990-2000: A Summary

3.1. Introduction

Table 3.1a. shows the individual components of the ISEW developed for Wales, and Table 3.1b shows the values for the individual components in £1995. This section will outline the components of the ISEW, describing the rationale for inclusion in the index, and trends in the individual components. The appendices contain details of calculation methods, and sources of original data. Moreover, the Phase 1 CCW report, 'Developing an ISEW in Wales' provides a review of issues and problems with each index component. The purpose of this section is then to give the reader some insight into the individual components, their magnitude and trend over the period 1990-2000.

All money figures are in terms of £1995 unless otherwise specified. At the outset it is important to note that one of the difficulties of producing an ISEW for any UK region is the absence of regional GDP/consumption deflators. In this report regional data has been deflated using the appropriate UK level deflators. Clearly, this is not ideal as there is some expectation that deflators if derived for Wales would be different, partially because of the very different nature of housing markets. Limited work has been undertaken by the ONS to construct regional price indices for a single year, but this information is not yet in a form which could be used to assist in the development of the ISEW such that there remains a reliance on UK deflators.

Table 3.1a. ISEW Components (Adjustments)

ISEW Element	Basis for inclusion
B Consumption expenditure	Estimate of welfare derived from goods and services
C&D Adjusted consumption (income inequality) (-)	Adjusting for the social effects of uneven income distribution
E Services from domestic labour (+)	Adding non-monetarised aspects of the regional economy that add to welfare
H Non-defensive public expenditures on health and education (+)	Adding health and education spending that adds to welfare
I-F Services from consumer durables adjustment (-)	Adjusting for the service value of a given level of consumer durable spending
J Defensive private expenditures on health and education (-)	Subtracting defensive spending
K Cost of commuting (-)	Subtracting defensive spending
L Costs of personal pollution control (-)	Subtracting defensive spending
M Cost of car accidents (-)	Subtracting defensive spending
N Cost of water pollution (-)	Subtracting costs due to environmental damage
O Cost of air pollution (-)	Subtracting costs due to environmental damage
P Cost of noise pollution (-)	Subtracting costs due to environmental damage
Q Cost of loss of natural habitat (-)	Adjustment for loss of natural capital
R Cost of loss of farmland (-)	Adjustment for loss of natural capital
S Cost of depletion natural resources(-)	Adjustment for loss of natural capital
T Cost of long term climate change (-)	Adjustment for long term damage to the environment affecting future generations
U Cost of ozone depletion (-)	Adjustment for long term damage to the environment affecting future generations
V Net capital growth (+/-)	Adjustment to take into account development of man-made capital

Table 3.1b ISEW Components

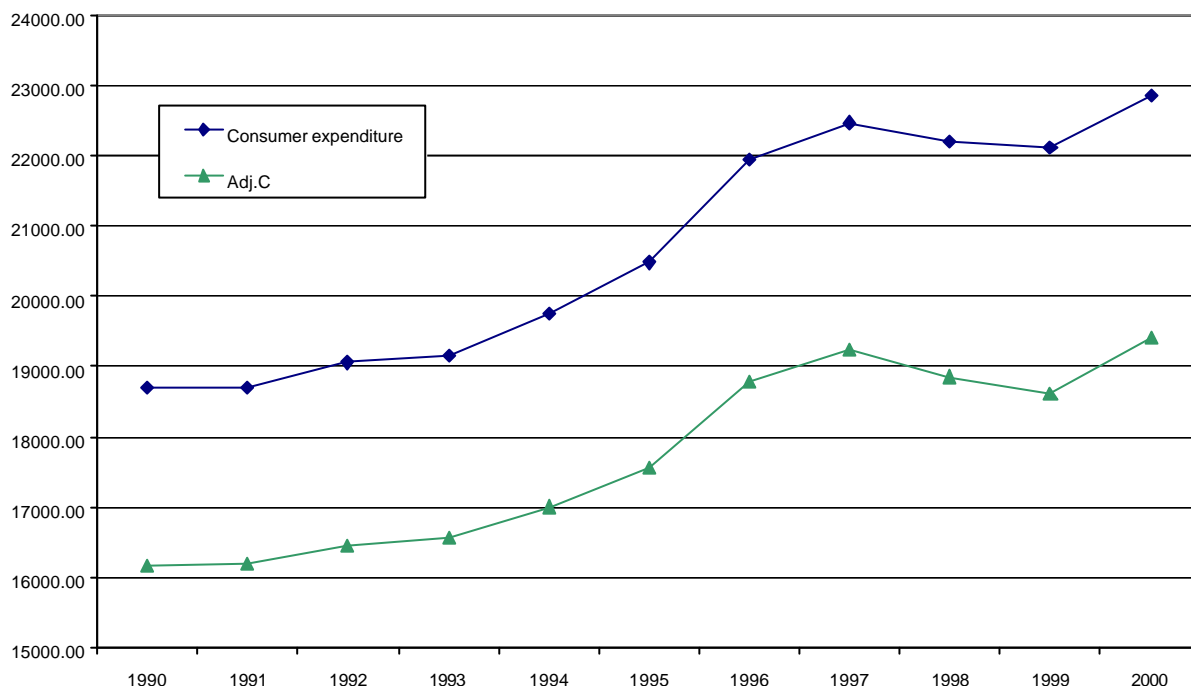
	B	C	D	E	H	I-F	J	K	L	M
Year	Cons. expenditure	Income Inequality	Adj.C	Services from dom. labour	Non. defensive public exps. on health & education	Services from cons. durables adjustment	Defensive pvt. exps. on health and education	Cost of commuting	Cost of personal pollution control	Cost of car accidents
1990	18689.13	0.1347	16171.70	4403.66	1252.48	585.31	232.09	1146.02	107.57	13.97
1991	18705.10	0.1341	16196.75	4450.47	1348.06	343.54	202.72	1151.44	120.57	12.60
1992	19057.24	0.1361	16463.55	4572.39	1443.92	319.45	184.46	1153.04	132.39	12.13
1993	19163.16	0.1355	16566.55	4678.77	1482.69	363.98	206.64	1156.64	141.84	11.38
1994	19760.33	0.1394	17005.74	4540.33	1595.79	464.58	200.19	1161.41	151.30	11.78
1995	20483.00	0.1420	17574.41	4517.31	1649.95	475.71	191.25	1151.45	165.48	11.39
1996	21941.69	0.1433	18797.45	4474.70	1685.72	608.16	259.11	1204.93	187.94	11.53
1997	22474.24	0.1433	19253.68	4476.35	1705.04	765.05	265.07	1208.35	192.50	11.12
1998	22205.99	0.1508	18857.33	4639.74	1738.67	888.06	271.00	1224.44	190.20	10.93
1999	22112.84	0.1583	18612.38	4645.65	1803.39	1044.16	206.24	1253.82	189.40	10.74
2000	22864.68	0.1508	19416.69	4725.71	1875.00	1270.21	238.70	1274.11	195.80	10.53
	N	O	P	Q	R	S	T	U	V	ISEW
Year	Cost of water pollution	Cost of air pollution	Cost of noise pollution	Cost of loss of natural habitat	Cost of loss of farmland	Cost of depletion of nat. res ources	Cost of long term climate change	Cost of ozone depletion	Net capital growth	
1990	262.41	1952.83	94.56	312.64	169.72	5569.23	4722.48	1815.60	1207.11	6050.53
1991	248.23	1885.71	95.11	320.26	171.77	5894.75	4847.59	1886.52	1035.67	5850.14
1992	231.68	1824.17	95.65	327.89	174.18	5994.14	4971.77	1926.71	982.52	6114.71
1993	329.19	1697.61	96.19	335.51	176.80	6287.93	5095.04	1906.62	833.94	5756.59
1994	253.73	1593.73	96.73	343.14	179.49	6382.66	5223.48	1880.61	847.52	6046.56
1995	205.91	1473.91	97.28	350.76	184.36	6601.35	5351.77	1891.25	938.49	6528.29
1996	193.42	1404.73	97.82	358.39	188.76	7160.53	5482.48	1964.54	1142.15	6977.68
1997	196.61	1297.20	98.36	366.01	189.67	7272.73	5608.91	1964.54	1298.59	7297.53
1998	136.03	1218.67	98.90	373.64	191.27	7623.03	5735.34	1964.54	1420.89	6730.56
1999	146.66	1098.75	99.45	381.26	190.68	7872.13	5861.77	1964.54	1497.91	6239.73
2000	164.19	1024.14	99.99	388.89	193.54	8178.37	5988.20	1964.54	1576.92	6603.10

3.2. Consumption expenditure

Individual consumption expenditure is the starting point for the construction of the Welsh ISEW. Consumption spending is assumed to provide an estimate of the total welfare that is gained from private goods and services.

Fig 3.1 shows consumption spending in Wales (£1995). This figure has grown from £18.7bn in 1990, to an estimated £22.9bn in 2000. Real consumption spending has increased by 22.5% over the decade. Consumption spending per head of the Welsh population was £6,486 in 1990 rising to £7,761 in 2000.

Figure 3.1 Consumption and Adjusted Consumption, Wales 1990-2000, £1995



3.3. Adjusted consumption (income inequality) (Columns C & D)

Consumption expenditure in column B is adjusted downwards to reflect the fact that a more even distribution of income in a region could have welfare enhancing effects. Less well off members of society are likely to gain more in welfare from a £1 increase in income than a richer person. Therefore a transfer of income from rich to poor that decreases inequalities may act to increase overall welfare. The method used to make this adjustment is based on the work of Atkinson (1983) and assesses the equivalent equalised income associated with each unequal distribution of income. This method relates different levels of income to the different levels of utility associated with them. The effect of the adjustment is to demonstrate that the region could get similar levels of welfare from a lower level of more equally distributed income.

For the period 1990-1996 data for making this adjustment was derived from the pilot ISEW research (Midmore et al., 2000). In the pilot study the UK correction for inequality based on distribution of post-tax incomes was applied in Wales (see also Jackson et al., 1997). Information for 1997-2000 was derived by extrapolating the series from the pilot based

upon information from Economic Trends (see for example, Lakin, 2002) on the distribution of post tax incomes at the UK level. On this basis the trend in income inequality in Wales is assumed to be similar to that in the UK i.e. inequality fell slightly during the first half of the 1990s, but rose again in the second half of the 1990s, and then flattening in 2000 (Lakin, 2002). Figure 3.1. also shows the adjusted consumption series.

3.4 Services from domestic labour (Column E)

The consumption of household services is expected to lead to improvements in welfare. However, this activity is generally outside of the market process. The value of household services is then an addition to consumption expenditure in the process of creating an ISEW. Making this adjustment requires information on the time spent by people in undertaking defined household services, and then information on the opportunity cost of this time i.e. perhaps in terms of other earning opportunities lost whilst undertaking housework.

The time spent in undertaking household work is likely to be significant. Gershuny and Jones (1987) calculated that an average of 15 hours a week was spent on domestic labour, this included cooking, washing, other housework, odd jobs and childcare. Other chores, for example, shopping and gardening, were not included in their study in the time allocation, because they were covered elsewhere or could be considered a leisure activity. More recent data on trends in household services are now available. The British Household Panel Survey (2001) found that women tend to do three-quarters of the housework, spending on average 18.5 hours a week on household chores compared to 6 hours for the average man. The 'Home Truths' report (a report by British Gas, 2001) found that men spent on average 5hr 27 minutes cleaning a week compared to 6hr 30 minutes for women. Information from these sources were combined with estimates of the opportunity cost of time derived from New Earnings Survey and based on wage rates for domestic cleaning services (although noting that in some cases this may undervalue the opportunity cost of time undertaking household work), and data on the Welsh adult population to derive the adjustment.

Figure 3.2 Estimated Value of Household Services (£1995m)

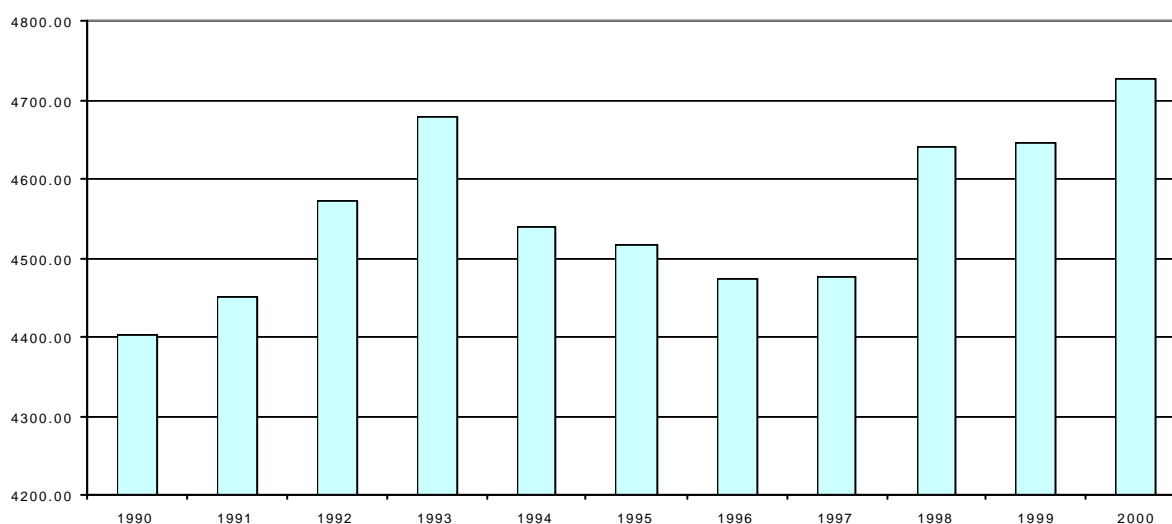


Figure 3.2. shows that the index adjustment for the value of domestic household services is fairly large ranging from £4.4bn in 1990, and growing to just over £4.7bn in 2000. The estimates for this adjustment are lower than those in the Welsh pilot ISEW (Midmore et al., 2000) because new household data more accurately shows the contribution of men and women in household services, and also uses a lower figure on total hours per week (i.e. 30 hours in the pilot compared to 24.5 hours in the revised ISEW for Wales).

3.5. Non-defensive public expenditure on health and education (Column H)²

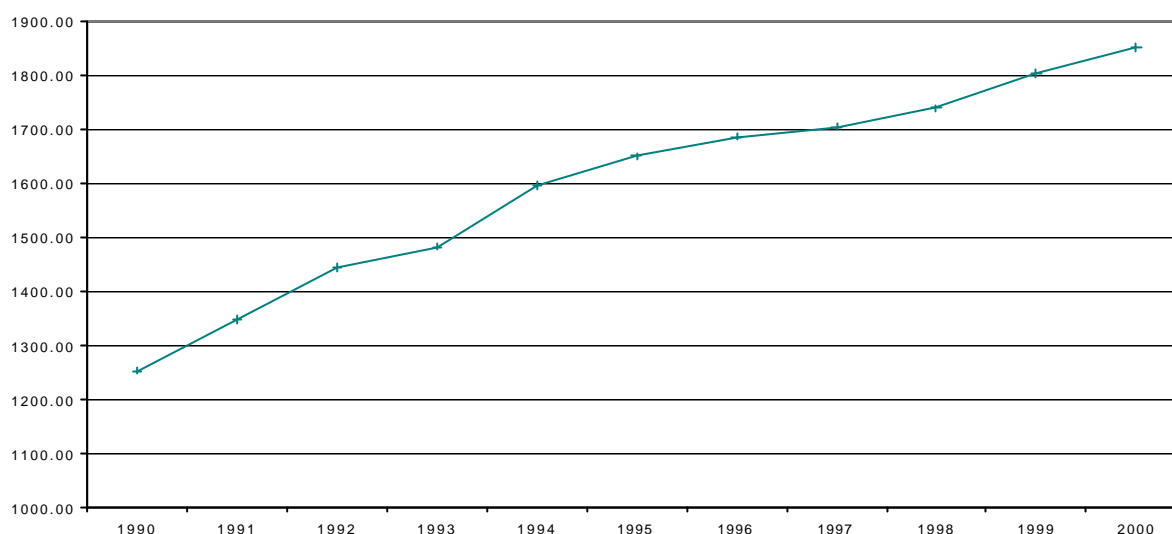
A proportion of public spending on health and education is expected to add to welfare although the precise nature of the connection is not always transparent (see Jackson and Marks, 1994; Daly and Cobb, 1989), with for example, some educational spending potentially being linked to labour market 'positioning activity' (see for example, Thurow, 1975).

At the same time a proportion public spending on health and education is defensive and does not add to welfare. Included here might be spending on pollution-related disease, and spending to educate and cure people of drug related problems. The consumer expenditure column (B) of the ISEW would include Welsh spending on items such as alcohol and cigarettes as an addition to welfare. Consequently, public spending associated with treating the costs of this consumption would not be included in a welfare measure. The Welsh ISEW works around the assumptions of previous ISEW research and assumes that one half of health expenditure is added to the index as it is assumed to be non-defensive, whilst one half of higher/further education expenditures are also included and assumed to represent pure consumption.

Figure 3.3 shows the trend in this index adjustment. In current prices total spending in Wales on health and personal social services increased from £1.74bn in 1990-91 to £3.46bn in 1999-2000. Higher and further education spending is estimated to have increased from £379m to £624m over the same period (both figures current). Half of these amounts is taken to be non-defensive over the period. Then Figure 3.3. shows that non defensive spending on health and education went from £1.25bn in 1990 to £1.87bn in 2000 (£1995). This represents a 48% increase over the period.

² Services from Streets and Highways (G). The Daly Cobb US-ISEW included an adjustment for 'Services from Streets and Highways' that was added to the index. This has not been included in the UK or Welsh studies. The Daly Cobb index generally excluded government expenditure on public services on the grounds that it is defensive. However, expenditures on streets and highways were deemed to be non-defensive and therefore an annual value of this service was included. This was estimated by taking expenditure on streets and highways, estimating the net stock, and then subtracting a proportion to account for non-welfare services (commuting). For the UK (and therefore Wales), as in the US, many government services are provided free and are therefore already implicitly included within personal consumption. But, in contrast to the US, UK roads can be considered to be financed through the taxation on vehicles and fuels. Since these payments are already included in personal consumption it is inappropriate to add an additional expenditure here. Therefore this column has been omitted from the index. It is, however, acknowledged that this is an incomplete solution to the problem as ideally the vehicle tax component of personal consumption (expenditure) should be subtracted and a value for services flowing from the expenditure added in. However, sufficient data to carry out this ideal calculation is unavailable.

Figure 3.3 Non-Defensive Public Spending on Education and Health £1995m



3.6. Services from consumer durables adjustment (Column I-F)

An important element of Welsh consumption expenditure is on goods such as washing machines, televisions, ovens etc. The majority of such goods last more than one year and provide welfare outside of one accounting period. The consumption expenditure base of ISEW includes spending on these goods which provide welfare in future periods. By the same reasoning, consumer expenditure on durables in 1999, for example, leads to welfare increases in 2000 and beyond. To estimate the ISEW, it is necessary to estimate the flow of services arising from a net stock of consumer durables in a given period.

Estimating this adjustment is very difficult in Wales because of a lack of detailed data on stocks of consumer goods and services deriving from them. For these reasons there was in the pilot research a heavy reliance on the UK ISEW framework as a base for the Welsh figure for the period. In the Welsh pilot index, UK differences between the spending on, and services from, consumer goods are multiplied by the share of Welsh consumer spending in that of the UK.

Improved data has now become available for the UK on 'flow of services' measures of consumption (see Hamilton and Morris, 2002). Data from this research relating to the flow of services from UK stocks of consumer goods has been used to inform this adjustment for Wales.

The adjustment for the difference between expenditure on and services from consumer goods was an estimated £585m in 1990 increasing to just over £1270m in 2000 (£1995). This is a subtraction from the index consumption base.

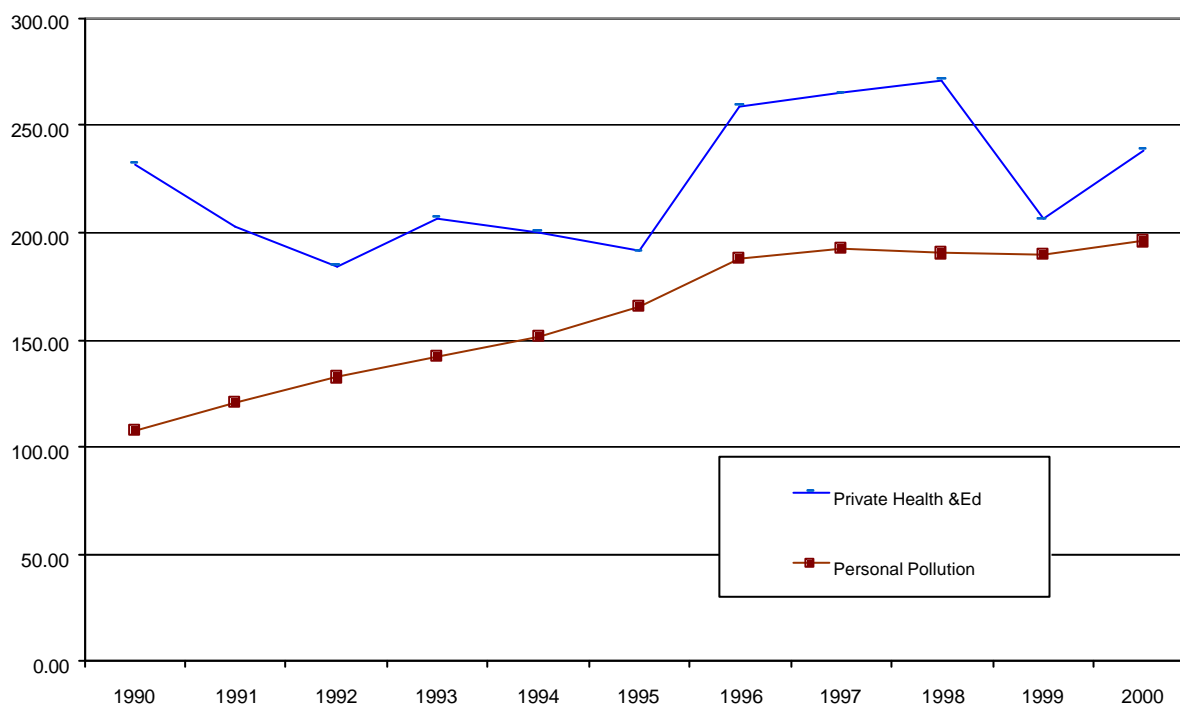
3.7 Defensive private expenditure on health and education (Column J)

Included in the consumption expenditures base are private expenditures on health and education which are likely to be defensive in nature (see also 3.5 above). Therefore these figures should be deducted from the index. Following previous ISEW research the approach taken here was to take half of estimated private expenditure on health and education and to assume that this is defensive.

Information for this index component is derived from the Family Expenditure Survey results for Wales which reveal household spend on items such as medicines, prescriptions, medical fees, medical insurance, and general education and training expenses. This is combined with information on number of households to get an overall estimate of private expenditure on health and education. For example, in 2000-01 defensive health expenditures in Wales were around £119.1m, and with defensive education expenditures of around £105.8m (current prices).

Figure 3.4. shows the ISEW series for this adjustment. There is some fluctuation from year to year largely because this component is heavily driven by an estimate of weekly spend from what is a small sample in the Family Expenditure Survey. In 1990 it was estimated that this adjustment to consumption was worth £232m and by 2000 was worth £239m (both £1995). This is small component of the overall ISEW i.e. the adjustment usually accounts for around 1-1.3% of annual consumption in Wales.

Figure 3.4 Defensive Expenditures (Private Health & Education, & Personal Pollution Control) £1995m.



3.8 Cost of commuting (Column K)

A proportion of consumption spending (Column B above) relates to costs involved in commuting to and from work. Within initial ISEW studies spending on commuting is assumed to be defensive, with costs resulting from patterns of urbanisation. The cost of commuting has two elements. First, there is the financial outlay on fares, fuel etc. However, there are also opportunity costs in terms of lost leisure. The Labour Force Survey reports that average travel to/from work time in Wales was 40 minutes in 2000.

The cost of commuting has been calculated using data from Family Expenditure Survey on the level of spending on various modes of transport (rail, bus, car and other which includes bicycle, tram and motorcycle). In 2000 average spending per Welsh household on these transport modes was an estimated £48.90 per week (including capital costs). This information is combined with estimates of the working population in these households to provide an estimate of the cost of commuting for 1990-2000. In addition a value is added to account for the value of lost leisure time derived from Department of Transport information used in standard cost-benefit analyses.

The cost of commuting adjustment was worth around £1.15bn in 1990 (£1995), and around £1.27bn in 2000. This is a significant component of the index accounting for almost 6% of consumption spending in 2000.

3.9 Costs of personal pollution control (Column L)

Consumption expenditure includes spending on items such as air purifiers and water filters. This type of spending in previous ISEW research has been regarded as defensive as the activity compensates for environmental damage. Consequently if spending on personal pollution control was included in the ISEW within consumption it would mean that welfare associated with that consumption spending would be over-estimated. A key difficulty with this adjustment is deciding what types of spending to classify as defensive.

The adjustment for personal pollution control was a small part of the UK ISEW (Jackson et al., 1997), and the Welsh pilot. The UK ISEW assumed that 5% of total environmental expenditures could be associated with households. In making this adjustment for Wales for 1990-1996 inference is drawn from the UK ISEW i.e. UK estimates are apportioned to Wales according to the overall Welsh share of UK consumer expenditure each year. Later index values are derived by simply assuming that expenditure on environmental goods is proportional to consumer expenditure such that proportional increases in Welsh consumer expenditure can be applied to the existing data for years 1997 onwards. On this basis the cost of personal pollution control in Wales in 2000 was an estimated £196m (£1995) or around 1% of Welsh consumption spending.

3.10 Cost of car accidents (Column M)

Another element of consumption that is defensive in nature and should be subtracted from the index is the cost of car accidents. The cost of car accidents is in some measure a real cost of industrialisation and increased congestion (i.e. a negative externality). The cost of an accident has two main components: the personal injury costs, and the non-injury costs. Defensive health expenditures are considered through defensive private expenditures, leaving the non-injury costs to be accounted in this adjustment.

Information is available from the Department of Transport, Local Government and the Regions on number of car accidents reported to the police within 30 days of the accident, and accidents are disaggregated into Fatal, Serious and Slight. The latter includes injuries requiring no medical treatment. Figures for all accidents including all non-injury are unavailable. Table 3.2 shows that in 2000 there were 11,822 reported incidents in Wales, of which one in five were fatal and serious accidents. By 1999, the total number of incidents had fallen as had the proportion which were fatal or serious.

Table 3.2. Fatal and serious road accidents in Wales

	Type of accident			Total	Fatal and serious as percentage all accidents
	Fatal	Serious	Slight		
1990	223	2,206	9,393	11,822	20.55%
1995	193	1,484	8,599	10,276	16.32%
1999	176	1,295	8,424	9,895	14.87%

Figures from Digest Welsh Statistics 10.11

The data in Table 3.2 is available for years between 1990-2000, although the numbers for 1998 and 2000 are estimated. This information is combined with estimates of the costs for injury accidents i.e. £2,596 and non-injury accidents at £871 (1998 prices) (see Taylor, 1990). The total cost of accidents is therefore based on these data.

The cost (in £1995) of car accidents in Wales fell from an estimated £13.97m in 1990, to around £10.53m in 2000. This fall is in large measure down to the 40% decrease in the number of serious accidents over this period. This adjustment is therefore a very small component of the ISEW.

3.11. Costs of water pollution (Column N)

The availability of high quality water is an important component of welfare, through the provision of both drinking water, and cleaning capacity. It is also a vital component of agriculture and manufacturing. Therefore it is necessary to include a cost to account for any loss of quality.

Available data suggests an increase in water (river) quality in Wales, however, tightening regulations on industry are more likely to be the cause of this rather than increased water company expenditure. An indicator for water pollution was taken as the length of rivers in Wales that are classed as either 'bad' or 'poor' by the Environment Agency in their river General Quality Assessment (reported in Digest of Welsh Statistics). This classes rivers by quality from A-F (A and B 'Good', C and D 'Fair' and E 'Poor' and F 'Bad'). The E and F classifications were chosen in preference to the others as it was felt they best represented polluted waterways and as the costs that were being used were for water pollution they seemed most appropriate.

An alternative river quality classification system considered was the River Ecosystem Score, However this data only began in 1995 and comparisons with the classification system describe above was not possible (see Appendix for more detail).

The total length for these two classes of rivers (E and F) was indexed to the 1992 length. This gave an indexed series form 1992 to 2000. Data on river quality prior to this series was based on a slightly different classification system that is not directly compatible. The cost for water pollution are based on UK-ISEW data. For the years 1990 – 1992 the same methodology as the pilot was used; that of apportioning costs based on the UK GDP. For subsequent years the index data described above was applied to the 1992 cost to produce a time series data until 2000.

The methodology used here is an improvement on the pilot study in that it used data based on actual records of river quality in Wales, whereas the pilot used UK water quality levels and apportioned a cost according to GDP. The pollution cost can therefore be seen

to be a reflection of Welsh river (if not water, see below) quality rather than a proportioned element of UK costs.

However this methodology is still felt to be deficient in certain areas. First, it does not account for sea water quality, which is of considerable importance from both a recreational (bathing and other activities) point of view³, various forms of pollution are implicated in damage to sea ecosystems, having consequences for the quality and quantity of fish catches. Second, it does not include ground water pollution. However, as noted in the UK-ISEW such data is not available. A third area for improvement is in the aesthetic value of rivers. The non-market valuation placed upon these resources by the public at large could be obtained from various approaches, such as travel cost or contingent valuation techniques, although these would need to be adjusted by the value of expenditures on clean-up costs and other improvements to water quality carried out by public authorities and utilities.

3.12. The cost of air pollution (Column O)

Air pollution imposes economic costs, for example, through loss of primary industry potential, and through reducing the quality of life. The main elements of air pollution are ozone, nitrous oxides, carbon monoxide, acid rain, volatile organic compounds and particulate emissions. This pollution arises through industry/household consumption and through transport activities. Table 3.3. shows estimated production of major air pollutants in Wales for 1990, 1995 and 2000 (see appendix for estimation process).

Table 3.3. Major Air Pollutants (000s tonnes)

Wales	1990	1995	2000
Nitrous oxide	145.30	109.80	79.53
Sulphur dioxide	229.76	145.91	71.96
Carbon monoxide	672.90	515.39	389.02
Volatile organic compounds	165.88	137.86	103.49
Black smoke	43.29	33.39	23.49
TOTAL	1257.14	908.96	644.00

Source: Derived from DEFRA information.

Whilst this is not a total list of emissions, the trend in production of these emissions is downwards in all cases – this is largely due to technological improvements in industry, cleaner vehicle emissions, and, in the Welsh case, due to changes in industrial structure.

Marginal costs for each of these pollutants has been derived from the UK ISEW research undertaken by Jackson et al., (1997) who in turn based their estimates on research by Tellus (1991) and Pace University (1990). For example, the marginal cost per tonne of sulphur dioxide is estimated at £1,231/tonne, whilst for volatile organic compounds it an estimated £2,312 per tonne (£1985 in both cases). Within the ISEW these figures are re-based to £1995. The cost of air pollution was then estimated to be £1.95bn in 1990 falling to £1.02bn in 2000. This is one of the few index components that decreased significantly over the period.

³ A recent report by *Nautilus* valued the recreational and commercial value of Welsh Coastal waters at £105 million (Study into Inland and Sea Fisheries in Wales – Prepared for the National Assembly)

3.13. Cost of noise pollution (Column P)

The costs of noise pollution are very difficult to evaluate. There are problems arising from measuring noise levels on a regional/national level, and different noise levels affect people in different ways. In Wales there is still very little quantitative information on noise levels although CCW have recently produced a tranquil areas map of Wales which also includes areas of light pollution (Rendel and ASH Consulting Group, 1996).

Sources of noise pollution include aircraft noise (in Wales largely through Cardiff International Airport - Rhoose), traffic noise, road works, construction, demolition and music reproduction. Evidence from DoE (1992) indicates that the number of complaints relating to noise has increased over the past few decades. Although improvements in engine design and more stringent regulations have had beneficial effects on noise pollution, this has been overshadowed by a much greater increase in the volume of air traffic (DoE, 1992) and road traffic (DoE, 1990; DETR, 1997).

Table 3.4 Selected Drivers of Noise Pollution in Wales

	Aircraft Movements through Cardiff airport (includes military movements)	Volume of road traffic (indicator of vehicle noise billions of vehicle km)	Additional Km new road build per year	Value of construction outputs £m
1990	61487	12.69	683	2,097
1991	53412	12.83	171	1,959
1992	53223	12.92	85	2,082
1993	55030	13.05	93	1,826
1994	55742	13.58	109	2,172
1995	55037	13.92	208	2,377
1996	59351	14.82	204	2,331
1997	60724	15.26	119	2,539
1998	65597	15.34	100	2,641
1999	63740	15.64	96	2,631
2000	64298	na	na	2,571

Sources: Digest of Welsh Statistics and Regional Trends various.

If noise levels can be inferred data in Table 3.4 then the various sources have all seen a slight increase over the ten year period, with the exception of road-works, which declined steeply in the first year and remained low (although this is new road build as opposed to repairs).

In estimating a value for noise pollution inference was drawn from the research in the UK ISEW (see also Maddison et al., 1996). Fundamentally this process required the estimation of the proportion of noise output coming from Wales with respect to the UK total. It was estimated that in 1990 the Welsh share of UK noise related outputs was 3.5% or £80.5m. This figure for 1990 was then indexed to an overall index of noise output in Wales derived from the type of information found in Table 3.4.

3.14. Costs of loss of natural habitat (Column Q)

Loss of natural habitats has become a serious issue in Wales. A proportion of this natural resource is lost each year in Wales, often due to new agricultural development or changes in farming practices. The scale of the depreciation of the natural habitat base is evidenced, for example, in studies which have shown that between the 1920s and the 1980s, 51% of dry heaths and 95% of wet heaths on the Llyn Peninsula were destroyed. Moreover, CCW (1993) demonstrates that 3,230 hectares of SSSIs in Wales are damaged in some way, albeit a proportion of this damage is not permanent.

Valuing the loss of natural habitats is difficult. First there is a problem of habitats classification. Information on changes in broad habitat categories is available from DEFRA i.e. in terms of hectareage and percentage changes in these habitats over the nine year period (1990 to 1998). This information is disaggregated into 21 major habitat types from broad-leaved woodland to urban land. Just over 44,500ha of habitat were estimated to have been 'lost' in the period 1990-1998, much being acid grassland. The main habitats to increase were arable/horticultural, bracken and broad-leaved woodlands. In order to give an indication⁴ of natural habitat loss only certain habitats were selected in making this index adjustment i.e. neutral grass, broad-leaved/mixed woodland, bogs, D-shrub heath, acid grass, fen/marsh/swamp, calcareous grassland, inland rock and montane (see also UK Biodiversity Action Plan). The loss of these habitats in Wales is estimated to equate to 3,325ha per year. The pilot Welsh ISEW by Midmore et al (2000) assumed a loss of 5,772ha per year. Variance is due to the inclusion of increase in certain habitats over the period, for instance broad-leaved mixed woodland increased by 6,280ha between 1990-1998.

A second problem is attributing a value to loss of habitat. Midmore et al used a value of £2000 for each hectare of habitat lost, and this was based on the Jackson et al., 1997 UK ISEW which in turn based estimates on two sources: the average price paid per hectare by the Royal Society for the Protection of Birds to purchase a 1,200 hectare site, and secondly the lower end of the range of willingness to pay values (£1,529 to £5,703 per hectare) for natural habitat areas in the South Downs (Willis and Garrod, 1995). The value of £2000 (£1990) is used to make the adjustment. Cost of habitat loss in Wales is then estimated to increase by £7.63m (£1995) per annum during the 1990s.

The cost of loss of habitat up until 1990 in Wales was estimated to be £312.6m (£1995 – see appendix for method), and that this increased to £388.9m by 2000. This is a fairly small component of the ISEW. For example, in 2000 the value of the loss of habitat component was around 1.7% of consumption spending in Wales for that year.

3.15. The cost of loss of farmland (Column R)

The development of the Welsh economy inevitably poses costs in terms of the loss of farmland. This adjustment therefore is designed to reflect the loss of productivity from agricultural land. There are two means by which sustainable productivity is reduced, first through physical loss of land from urbanisation, be it road building or housing, and second, deterioration of soil quality from erosion and poor management.

⁴ Only an indication can be given because the data only gives broad habitat statistics. So a loss of an area of semi natural oak woodland would be seen to be offset by planting a similar sized area of saplings as all are classed as broadleaved woodland.

The area of farmland lost was identified using statistics from the agricultural Census on total agricultural land. A time series on land lost as a result of urbanisation was unavailable. However DEFRA are beginning to gather such statistics which may therefore be able to better inform any future ISEW developments.

In assigning a cost to loss of farmland the average market price for *land only* sales in any one year was used. This value is likely to underestimate the future value as the market value reflects present productivity that is enhanced by chemicals and fertilisers. Should these no longer be available land prices are likely to rise as productivity per unit of and falls. However, as a more ideal value of land is unavailable the market value has been used.

Estimating a value for loss of farmland productivity as a result of soil degradation is difficult as many factors contribute to loss, and these are varied and complex. For instance use of chemicals can mask productivity decline of the soil in the short term, but contribute themselves to soil depletion in the longer term. Also poor soil management can enhance the breakdown of soil structures.

The value of soil loss is further complicated by the fact that erosion is a natural process such that identifying the amount that is a direct result of agricultural practices is almost impossible. The data used for the amount of soil erosion in Wales was derived from work by Evans (1993), and the UK figure from the Evans research was apportioned to Wales based upon the area of arable land.

3.16 Cost of depletion of natural resources (Column S)

Conventionally, the growth of the Welsh economy has been measured in terms of increases in real GDP. This measure takes into account the fact that in accessing economic opportunities capital is used up. However, GDP, as conventionally measured, takes no account of the usage of natural capital. This is likely to be important because the use of natural capital to enable consumption now could mean that there is reduced natural capital to provide consumption opportunities for future generations. In the ISEW framework the cost of replacing used up environmental assets should be deducted from the index.

This component of the index then requires some information on the stock and usage of non-renewables in Wales, and then an estimate of the cost to replace these non-renewables. The pilot ISEW (Midmore et al. 2000) followed the method adopted in original ISEW work (Cobb and Cobb, 1994) on the basis that the cost of any non-renewable resource is that of its nearest renewable substitute i.e. the cost of a gallon of petrol conventionally produced is estimated from the cost of equivalent fuel produced from renewable sources, for example, fuel derived from sugar cane.

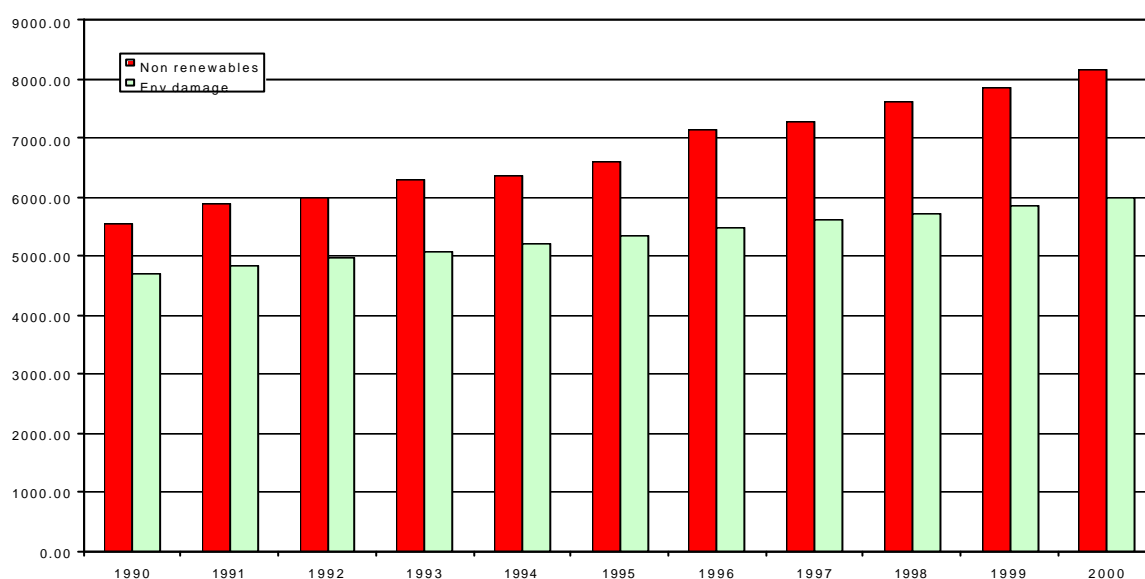
In Wales there is no detailed account of the physical stock of non-renewables, or how such non-renewables are used. The adjustment in the Welsh ISEW follows the methodology used by the Jackson et al (1997) UK ISEW, where figures are based on a replacement value to every barrel of oil equivalent of energy resources consumed over the period. This value reflects the cost of replacing each barrel of oil equivalent of energy consumed with renewable energy resources.

Welsh information on primary resource consumption was based on information relating to manufacturing output, domestic spending on fuel, and number of vehicles (see Appendix). It is estimated that Wales accounts for an average of around 6% of the energy

consumption of the UK over the period. Estimates of energy consumption (barrels of oil equivalent) are then multiplied by the value of producing these resources by renewable means to estimate the cost of using non-renewables. It is estimated that the cost of using non-renewables up until 1990 was £5.6bn (£1995). During the 1990s this figure increases to a little under £8.2bn (see Figure 3.5). This is a large part of the ISEW in any year. For example in 2000 this represented 37% of consumption spending.

It is expected that AEA Technology data being provided for the Environment Agency on fuel usage and resulting emissions could also inform this important adjustment for Wales in the future.

Figure 3.5. Cost of Non-Renewables and Cost of Long Term Environmental Damage (£1995)



3.17 Costs of long term climate change (Column T)

This adjustment to the ISEW focuses on the long-term environmental damage caused by greenhouse gas emissions. The adjustment entails multiplying a 'marginal social cost' for each tonne of greenhouse gas produced (which reflects the total discounted value of all future damages arising from that tonne of emission). The marginal social cost of each tonne of greenhouse gas produced is calculated with reference to research by Fankhauser (1994).

Data on the production of greenhouse gases in Wales has improved in the recent past with data from AEAT - National Atmospheric Emissions Inventory, which provides emissions by country for certain pollutants, including Carbon, Methane and Nitrous Oxides. In 1990 Wales produced an estimated 6% of UK greenhouse gases.

Table 3.5 UK Carbon equivalent emissions (million tonnes carbon equivalent)

		1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
UK	CO ₂	164.5	165.5	161.5	157.3	156.2	153.7	159.1	152.5	153.2	150.8	152.1
	CH ₄	20.9	20.6	20.1	19.2	17.4	17.3	17.0	16.3	15.6	14.8	13.9
	N ₂ O	18.5	18.0	16.1	15.1	16.3	15.6	16.1	16.6	15.8	12.2	12.0
	Basket total	208	208	202	196	194	191	197	191	191	181	181

Estimated total emissions of UK 'basket' greenhouse gases on an IPCC basis weighted by global warming potential: 1990-2000 (2001 provisional for CO₂)

The costs of long climate change is another large component of the ISEW, increasing by almost 27% from a cost of £4.7bn in 1990 to just under £6.0bn in 2000 (£1995). Over the same period Welsh consumption expenditure rose by 22.5%.

3.18. Cost of ozone depletion (Column U)

Chlorofluorocarbons (CFCs) are a substance used in fridges and aerosols, and have been associated with depletion of the ozone layer. Depletion of the ozone layer is connected to a number of environmental and health risks. International pressure resulted in the 1987 Montreal Protocol which led to the reduction of global production and consumption of CFCs.

The Welsh ISEW followed the procedure adopted in the UK ISEW. Since detailed ozone consumption statistics are not available for Wales, the pilot study derived an estimate of Welsh consumption of CFCs on the basis of the Welsh share of UK consumer expenditure. The total cost of ozone depletion in each year is estimated by multiplying the accumulated consumption up to that year by a cost per kilogram of consumption (a figure based on data in Cobb and Cobb, 1994).

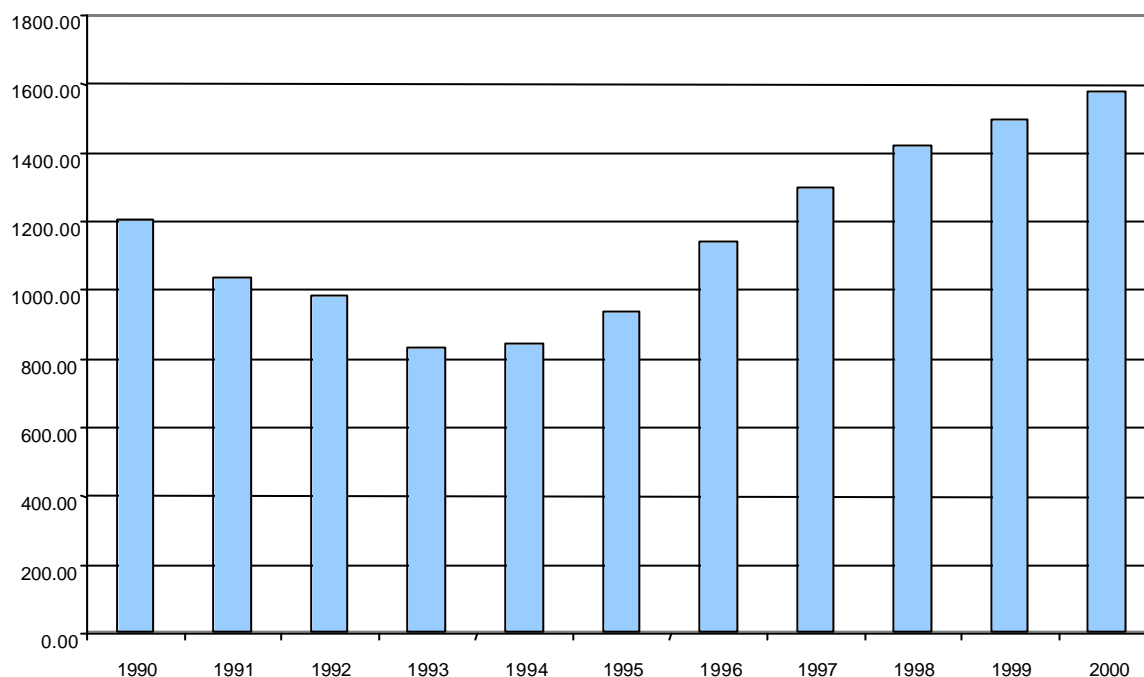
The table shows the effects of the Montreal Protocol, whereby production and consumption of CFCs has effectively ceased. Accumulated consumption of CFC should not increase above 1996 levels, and thus the costs of ozone depletion is unlikely to change significantly in future years. For this reason the values in the pilot ISEW are taken for 1990-1996 and then projected forward with no change. This assumes that no further damage is expected from CFCs in the future. However, how far previous damage can be reversed is open to question.

3.19 Net capital growth (Column V)

This adjustment accounts for changes in the net stocks of human made capital over time. Where consumption depletes human as well as environmental capital this cannot be regarded as sustainable. GDP calculations include investment expenditure in terms of gross domestic fixed capital formation (GDFCF). However, if an ISEW has consumption as a base, then the simple addition of GDFCF ignores the depreciation of capital. Moreover, some account needs to be made for increases (or decreases) in the need for capital to provide for increases (or decreases) in the workforce (see Jackson et al., 1997). Changes in the workforce require comparable changes in the level of capital stock (so that the level of capital per worker is either constant or increasing, to ensure economic sustainability).

The net capital adjustment is then a measure of the net increase (or decrease) in both public and private capital after adjusting for changes to the workforce requirement. Information to make this adjustment has been derived from a variety of sources in national and regional sources (see Appendix). Figure 3.6 shows estimated net capital growth between 1990 and 2000.

Figure 3.6 Net Capital Adjustment (£1995)



3.20 Conclusions

A large number of adjustments to consumption have to be made to estimate an ISEW. This section has shown that there is still a reliance on the UK and international ISEW framework for some adjustments. However, in estimating an ISEW Wales for the period 1990-2000 several improvements have been made over the pilot research including:

- Use of new information on the flow of services from consumer durables at the UK level (Column I-F).
- Introduction of updated and region specific data to calculate the domestic labour services adjustment (Column E).
- More finely disaggregated information for Wales to calculate defensive public and private expenditures (Column H & J).
- Use of new data from the Labour Force Survey to estimate commuting times (Column K).
- Use of improved data on volumes of pollutants for Wales (Column O & T).
- Use of more finely disaggregated information on habitat loss (Column Q).

In addition to the above, in coming to estimates for 1990-2000 it has been possible to use, in most cases, consistent data covering the whole of the period with fewer methodological breaks. The next section contains a commentary on the developed ISEW.

4. ISEW for Wales 1990-2000

4.1. The Welsh ISEW

Table 4.1. ISEW for Wales 1990-2000

Year	GDP	ISEW	GDP/capita	ISEW/capita
	£m (1995)	£m (1995)	£ 1995	£ 1995
1990	24085.11	6050.53	8358.82	2099.86
1991	23872.51	5850.14	8270.69	2026.79
1992	23591.68	6114.71	8139.27	2109.61
1993	24107.07	5756.59	8294.19	1980.59
1994	25090.26	6046.56	8613.20	2075.72
1995	25989.00	6528.29	8910.11	2238.17
1996	26153.92	6977.68	8953.45	2388.72
1997	26374.76	7297.53	9011.78	2493.43
1998	27002.74	6730.56	9206.53	2294.77
1999	27376.45	6239.73	9321.23	2124.53
2000	28142.99	6603.10	9552.95	2241.38

Table 4.1. (see also Figure 4.1) shows the ISEW for the period 1990-2000 (all figures are in 1995 pounds). The value of the ISEW was £6.05bn in 1990 – between 1993 and 1997 it increased in value to £7.3bn. This was followed by a sharp fall in the ISEW for 1998 and 1999, and then an increase into 2000. The net result of these movements was that by 2000 the value of the ISEW was 9.1% higher than it had been in 1990. Table 4.1. demonstrates that after 1992 the trend in real GDP was steadily upwards, whereas the ISEW lost over £1bn between 1997 and 1999. This sharp fall after 1997 was largely caused by an increase in the income inequality adjustment to consumption expenditure (Column C). Recall from section 3.3. that a more even distribution of income in Wales is expected to be associated with higher levels of welfare and vice versa. The adjusted consumption base (Column D) fell by over 3% between 1997 and 1999 (around £640m). Similarly the adjustment for income inequality fell between 1999 and 2000 which helps to explain the increase in the ISEW in the final period. This highlights that values of the ISEW are sensitive to selected adjustments (see also Stymne and Jackson, 2000).

The value of the ISEW is typically within a range of 23-28% of GDP between 1990 and 2000. In the UK ISEW (Jackson et al., 1997) the index value was around 24% of GDP in 1996.

4.2. ISEW per capita

In the pilot Welsh ISEW the period 1990-94 saw the ISEW per capita falling, but then increasing very slightly in 1995 and 1996. Table 4.1 shows the trend in ISEW per capita for 1990-2000 for the revised index. At the start of the period the ISEW per capita stood at £2,100, and was £2,241 at the end of the period. This compares with GDP per capita values for 1990 and 2000 of £8,359 and £9,553 respectively. Figure 4.2. provides an index for GDP and ISEW per capita with 1990 GDP per capita equal to 100. This shows that ISEW per capita grew a little faster than GDP per capita between 1993 and 1995, but then fell sharply, whilst the trend in GDP per capita has continued steadily upwards.

Figure 4.1 ISEW and GDP (Wales) 1990-2000 (£1995m)

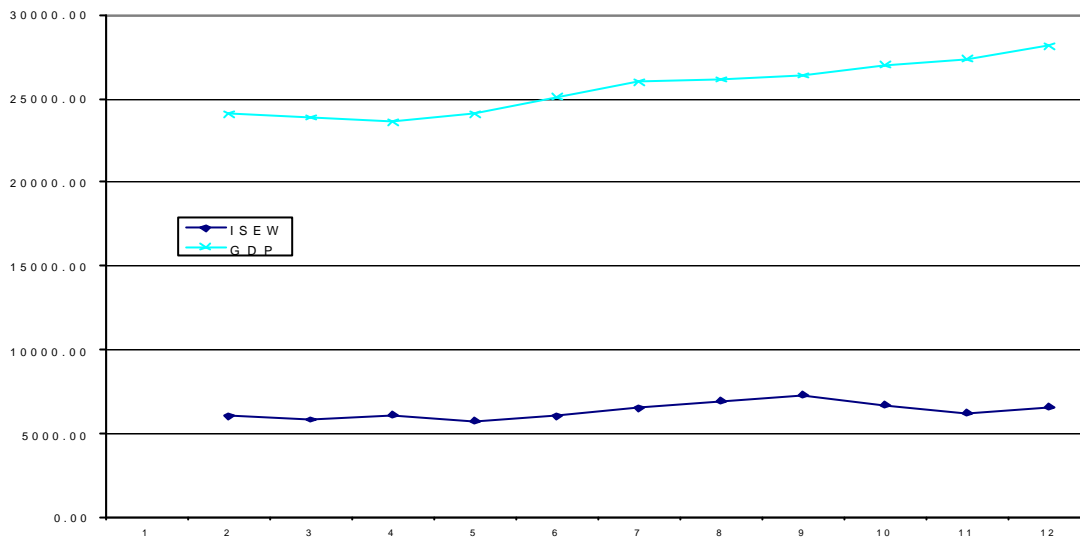
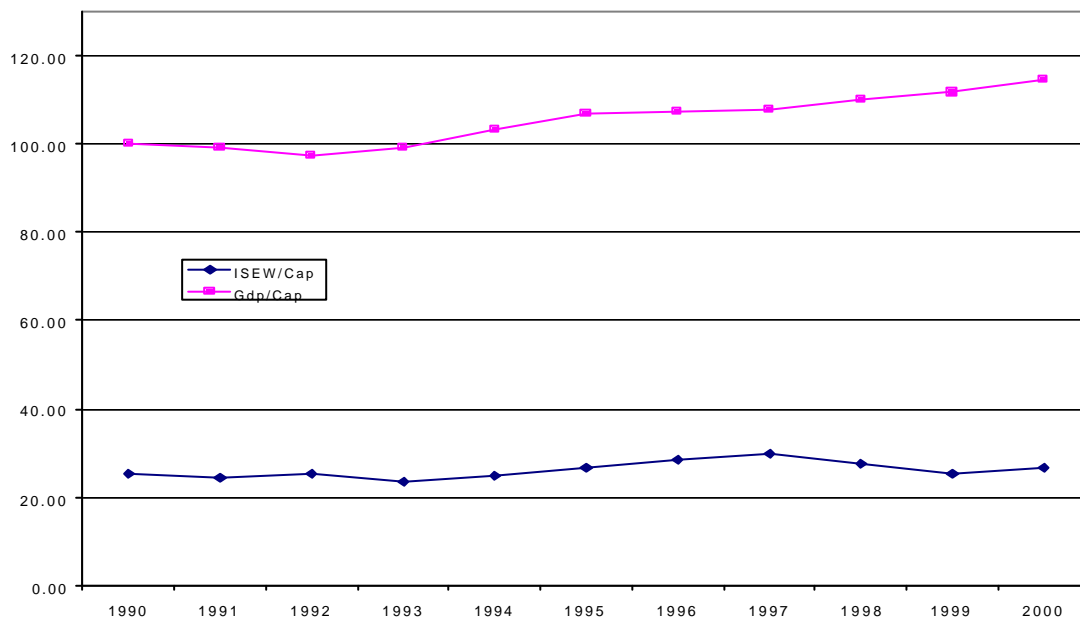


Figure 4.2. GDP and ISEW per Capita (1990 GDP per capita =100)



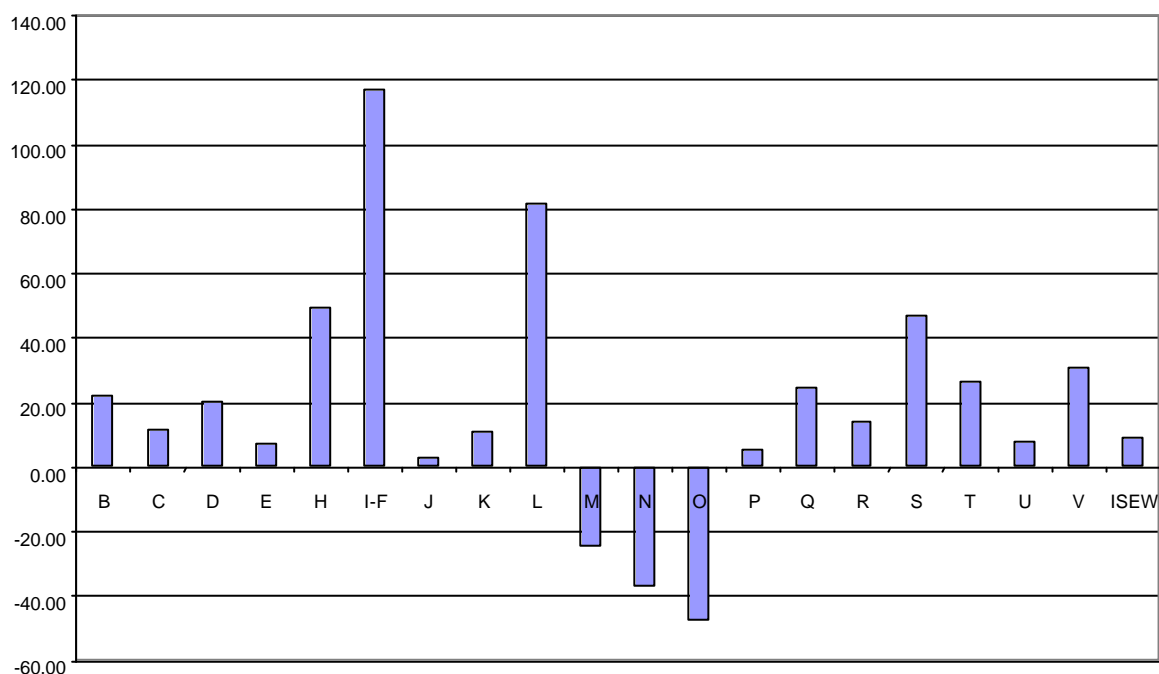
4.3. ISEW-GDP per capita gap

In overall terms the gap between GDP per capita and ISEW per capita increased during 1990-2000 i.e. from £6,259 in 1990 to £7,312 in 2000. Then whilst the ISEW per capita was 6.7% higher in 2000 than it had been in 1990, GDP per capita had increased by 14.3%.

4.4. Component changes

Figure 4.3 (see also Table 4.2) shows percentage changes in individual ISEW components over the period 1990-2000. The largest real changes were in the services from consumer durables adjustment (117%), public non-defensive expenditure on health and further/higher education (48%), costs of personal pollution control (82%) and costs of non-renewables (47%). The majority of 'cost' items in the Welsh ISEW have increased over the period. Exceptions are the cost of accidents (a small part of the ISEW) and the costs associated with air and water pollution. The percentage differentials hide the magnitudes of actual changes in some of the columns of the ISEW. The largest changes between 1990-2000 were in adjusted consumption (+£2.8bn), non-renewables (-£2.6bn), and long term environmental change (-£1.3bn). The cost associated with air pollution fell by around £0.9bn over the period.

Figure 4.3. Change in ISEW Components 1990 - 2000 (%)



The relative influence of individual ISEW components can be indicated by examining the proportionate value of the component compared with the value of the consumption expenditure (the basis for ISEW) in the year 2000.

The first column of Table 4.2 lists the component, and the second and third columns give the value (in £bn) in 1990 and 2000 respectively. The final column measures the proportionate change in the value of the component in that period. The fourth column indicates the relative importance of the component in ISEW by relating its value in 2000 to the value of consumption expenditure (column B).

Table 4.2 demonstrates that there are four “big hitters” in terms of ISEW:

- Column D adjusted consumption;
- Column S cost of depletion of natural resources (primary fuels) (a cost which increased by 47% over the period, which is subtracted from the value of consumption);

- Column T cost of long-term climate change (a cost which increased by 27% over the period, which is subtracted from the value of consumption);
- Column E services from domestic labour (this adjustment is added to the index, and increased by 7% over the period).

Table 4.2. ISEW: Movements in Components

Component	Value 1990 £1995m	Value 2000 £1995m	Value 2000/Col. B	% inc.in components 1990-2000
B Consumption expenditure	18689	22864		22%
D Adjusted consumption (income inequality)	16171	19416	85%	20%
S Cost of depletion natural resources	5569	8178	36%	47%
T Cost of long term climate change	4722	5988	26%	27%
E Services from domestic labour	4403	4725	21%	7%
U Cost of ozone depletion	1815	1964	9%	8%
H Non-defensive public expenditures on health and education	1252	1875	8%	50%
V Net capital growth	1207	1576	7%	31%
K Cost of commuting	1146	1274	6%	11%
I-F Services from consumer durables adjustment	585	1270	6%	117%
O Cost of air pollution	1952	1024	4%	-48%
Q Cost of loss of natural habitat	312	388	2%	24%
J Defensive private expenditures on health and education	232	238	1%	3%
L Costs of personal pollution control	107	195	1%	82%
R Cost of loss of farmland	169	193	1%	14%
N Cost of water pollution	262	164	1%	-37%
P Cost of noise pollution	94	100	>1%	6%
M Cost of car accidents	14	10	>1%	-29%
ISEW	6050	6603	29%	9%

4.5. Conclusions

Whilst the analysis of the individual components shows some good news in terms of falling costs of air and water pollution, and costs associated with ozone depletion, the majority of cost items are still rising. ISEW research in other countries including Australia, USA, and the Netherlands reveals for the early 1990s a sharp divergence between GDP and ISEW. In Wales this pattern seems to be maintained into the late 1990s with little evidence that the ISEW-GDP gap is closing in any meaningful way.

5. Policy and Practice: Some Implications of the ISEW for Wales

5.1. Introduction

Section 2 of this paper contrasted the ISEW against other aggregate indicators of sustainability such as the ecological footprint, and environmental satellite account. Currently a number of approaches are being developed in Wales to monitor progress towards sustainable development objectives, but few resources have been expended to examine the practical relevance of these measures and their wider public utility. This section considers some of the implications arising from the development of the ISEW for Wales 1990-2000.

5.2. ISEW is not a replacement for GDP

The ISEW combines economic, environmental and social factors into one overall measure of welfare. For this reason it has been argued that ISEW might be considered as a replacement for more conventional measures of progress such as GDP. Practically this is unlikely. In the case of GDP-based measures there is a well developed theoretical base, and a fairly transparent and internationally consistent methodology for construction which makes estimates comparable. In the case of the ISEW international consistency and acceptability are some way off. However, GDP is a socially constructed variable which plays an important role in influencing government and individual behaviours. In time an ISEW could perform a similar role.

In addition measures such as ISEW enable a better understanding of what the conventional approaches purport to measure and their weaknesses. The value from an ISEW can also be demonstrated when it is set against trends in other economic and social indicators of progress. Such a measure enables an understanding of the expected components of welfare gains in Wales, and more importantly the costs associated with 'progress'.

5.3. ISEW is a complementary approach

The corollary of the above discussion is that in Wales there is expected value in developing ISEW amongst a series of indicators. There would be value in adopting the ISEW as one of the headline sustainability indicators for Wales. Section 2 of this report demonstrated the various merits and demerits of a number of aggregate indicators of progress. The discussion centred on the practical relevance of approaches, and issues of construction and cost. The review found particular merit in the development of environmental satellite accounts for Wales, in a similar vein to those available for the UK as a whole. Such an approach reports physical and money values, and can provide a wide range of information relating to defined industry groups. The development of an ISEW could be seen as complementary to satellite accounts of this nature. Indeed information within a developed Welsh environmental satellite account would inform the construction of several ISEW adjustments, and vice versa.

5.4. A partial approach

In developing aggregate indicators of progress in Wales it must be remembered that resources are severely limited. The costs of developing data to inform each of the ISEW adjustments more perfectly would be very high. Initial ISEW developments were undertaken in much larger economies (e.g. USA) than Wales with detailed series of

macro-economic accounts, and longer series on which to development estimates of the environmental costs of progress.

This report presents a partial approach to ISEW construction whereby inference is drawn from UK and international research where regional data is not available. As Midmore et al. (2000) highlighted in their pilot ISEW research, the use of pro rata calculations based on UK data for the production of regional statistical aggregates has been established in other areas. Importantly, the marginal costs of developing an ISEW using a combination of regionally based adjustments and nationally based estimates is relatively low when compared, for example, to some of the alternative considered in Section 2 of the report. The information base on which to estimate an ISEW is overall improving all the time. In the interval since the construction of the pilot ISEW for Wales (undertaken in 1999-2000), several new data sources have become available at a regional level providing information on household working patterns, income inequality, levels of pollutants and losses of natural habitat. However, some data series have disappeared such as information of regional capital formation.

5.5. The Welsh Assembly Government's duty

The Welsh Assembly Government still has relatively limited information on which to assess its progress towards sustainable economic development. The nature of information currently available means that it is very difficult in Wales to make a judgement on the extent to which the Assembly has made progress towards its statutory obligation on sustainability. The developed ISEW is one addition to a much larger suite of information that would be required to make a more thorough assessment. There will continue to be criticisms of the method used to compile such indices. However, the existence of an ISEW can assist policymakers to ask appropriate questions, and make more informed judgements. For policymakers there is also value in the underlying physical and financial data used to construct the index.

5.6. Trends in the ISEW and Policy

The overall trend in the ISEW for Wales is still not particularly encouraging. If current patterns of consumption and activity are maintained in Wales there is every indication that the gap between the ISEW and GDP will increase. It is unlikely that this long term trend in the ISEW can be arrested completely. A reasonable strategic aim of policy in the shorter term might be to arrest the rate of decline in the ISEW, or investigate the increases occurring in those components which take away from welfare. As highlighted in the first ISEW report, a key aim of index construction is to promote understanding of factors that contribute and take away from sustainable welfare.

The nature of the relationship between GDP and ISEW could also be the context of broad policy objectives. Policy could focus on closing the gap between the GDP trend and the ISEW trend (whether the trend is expressed in absolute terms or in *per capita* terms). This would then require a policy objective committing WAG to securing, year on year, a more than proportionate increase in the value of ISEW compared with the proportionate increase in GDP. However, simply expressing policy objectives in terms of 'closing the gap' is imprecise – such an objective could be achieved within a period of falling GDP, which is clearly undesirable in terms of achieving the economic objectives of sustainable development.

The Welsh Assembly Government may have limited ability to influence some of the component trends. However, in others, regional government choices can have an important bearing – examples include:

- ISEW highlights the significance of attaining a higher degree of regional income equality. Elements of Assembly policy are already addressing this problem indirectly, for example, through initiatives to improve activity rates, assist disadvantaged areas within Wales, and through promoting equality in the workplace. However, at present very little is known on the extent to which the various policies adopted in Wales and/or Westminster serve to increase or decrease equality. ISEW demonstrates that improving the distribution of income can be linked through to gains in welfare.
- Development of several elements in the ISEW can potentially be related to planning processes and decisions including costs associated with air and noise pollution, as well as costs associated with loss of farmland, and habitat. Indeed legislation has already been associated with reductions in some of these items.
- Cost of commuting and car accidents where trends can be influenced by encouragement of different patterns of commuting, enhanced road safety measures, and improvements to public transport infrastructure.
- Improving education on the nature of sustainable economic development, and the costs of economic development. Encouraging new patterns of consumption.

There is also the potential to concentrate on the large components of the ISEW i.e. the ‘big hitters’. In this context the ISEW can also be connected to extant policy objectives. For example, the UK Government has a domestic policy target of achieving a 20% decrease in CO₂ emissions by 2010 (based on 1990 levels), and has now accepted that the UK needs to achieve a 60% reduction by 2050. Hence the political imperative to de-couple growth from carbon emissions has been established. ISEW then can be used to record the welfare implications of this policy (within the context of the bundle of components that together make up ISEW), and can also act to provide an additional rationale for the target, rather than act as a key driver for such a policy. In other words, there is nothing to suggest in this case that adopting the suggested ISEW policy objective would distort existing policy priorities.

5.7. Moving towards sustainability indicators

In conclusion much of this report demonstrates that ISEW is not a complete answer to monitoring trends in sustainability and welfare in Wales. ISEW is one part of a sustainability indicator set. Unfortunately, at the end of the Welsh Assembly Government’s first full term there is still very little information on which to assess progress towards sustainability objectives. Both the ISEW and the ecological footprint measures reveal that Wales is developing in an unsustainable way. When such approaches are combined with the physical and financial data in a regional environmental satellite account, then it would be possible that the Assembly’s progress towards its sustainability duty could be more accurately assessed.

6. Conclusions – Recommendations for Dissemination

6.1. Main findings from the ISEW 1990-2000

The main findings relating to the ISEW developed in this report were:

- The value of the ISEW was £6.05bn in 1990, and increased to £6.60bn by 2000.
- By 2000 the value of the ISEW was 9.1% higher than it had been in 1990.
- The value of the ISEW is typically within a range of 23-27% of Welsh GDP.
- In 1990 the ISEW per capita stood at £2,100, and was £2,241 at the end of the period. Over the same period GDP per capita values for Wales were £8,359 and £9,553 respectively. Thus whilst the ISEW per capita was 6.7% higher in 2000 than it had been in 1990, GDP per capita has increased by 14.3%.
- The gap between GDP per capita and ISEW per capita increased during the 1990s.
- The largest changes in ISEW components between 1990-2000 were in the services from consumer durables adjustment (+£0.7bn), adjusted consumption (+£3.2bn), non-renewables (-£2.6bn), and long term environmental change (-£1.3bn). The cost associated with air pollution fell by around £0.9bn over the period.

GDP per capita in Wales has steadily increased during the 1990s. There is very little evidence to suggest that the ISEW-GDP gap is closing.

6.2. Moving ISEW forward?

The final part of this report briefly outlines some possibilities for dissemination of the findings of this report. Several options are available:

- Inclusion of the ISEW on the websites of the CCW and/or the ESRC funded centre for Business Relationships Accountability Sustainability and Society. Such a website would carry a brief review of the ISEW method, graphical representations of ISEW trends from other countries, and then a description of the Welsh ISEW. Graphical presentation of the Welsh ISEW, could be supported by tables giving the nature of components and a brief commentary on each one. Connected pages would examine other alternative economic indicators for Wales with commentaries. Wider links could be developed to sources of key statistics (including ONS environmental satellites), related reports, supporting institutions, and through to related policy, initiative and strategy pages in these institutions.
- A short, pamphlet style report highlighting the index trend and the differential with standard growth measures such as GDP. Such a pamphlet would contain some of the information incorporated into the website, and contain supplementary information on other indicators, and possibly an outline environmental satellite account (e.g. in terms of industry pollution coefficients for Wales, carbon use etc). The research team would provide input for the pamphlet which could then be produced by CCW and disseminated.

- An article(s) in the *Welsh Economic Review* looking at methods and trends in components of the index. The Review could also provide a mechanism for publicising updates to the ISEW in future years. The Welsh Economic Review is circulated widely in Wales and includes copies to schools, AMs, MPs, universities and colleges, industry, trades unions, and local/regional government.

It is possible that each of these avenues could be followed up simultaneously. Several other points are noteworthy:

- There remains a need for a watching brief on environmental and economic statistics. Even in the period between the Phase 1 ISEW report and the development of the index for 1990-2000 there have been some significant improvements in statistics. For these reasons new statistics and information needs to be systematically incorporated into index development.
- There remain areas where new research would contribute to further ISEW development, for example in terms of research into regional price deflators, and regional income inequality.
- Finally, it is important to re-iterate a conclusion from the Phase 1 ISEW report regarding ISEW's role as an educational resource. Directing resources to education in sustainable economic development should be an important component of new policy and a developed ISEW could have a role in improving understanding of the connections between patterns of consumption and long term welfare trends.

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Index of Sustainable Economic Welfare (ISEW)

Technical Appendix

As far as possible the UK-ISEW methodologies were followed for each column adjustment together with relevant Welsh data. Where this was not possible, due to a lack of Welsh-specific data, indicators were used to apportion UK values for Wales.

All data was converted into 1995 pounds (£1995)

Each element in the ISEW is given a letter (from A to V), and this letter corresponds to the data columns in Table 3.1b of the main report.

Year (A)

Data was collected for years 1990 to 2000.

Consumption Expenditure (B)

Consumer expenditure data was collected for the years 1990 to 1999, with the figure for 2000 being estimated. Consumption expenditure data for Wales is available from the Office for National Statistics, and is published in *Regional Trends*. This data was then converted to £1995 using the appropriate national deflator. Please see the note in the main text on the difficulties of using UK-based deflators on UK regional data. Table B1 below shows consumer expenditure for the period 1990-2000 in £1995.

Table B1 Consumption and adjusted consumption

Year	B. Consumer Expenditure £1995	C. Effects of income distribution	D. Adjusted Consumer Expenditure £1995 B*(1-C)
1990	18689.13	0.1347	16171.70
1991	18705.10	0.1341	16196.75
1992	19057.24	0.1361	16463.55
1993	19163.16	0.1355	16566.55
1994	19760.33	0.1394	17005.74
1995	20483.00	0.1420	17574.41
1996	21941.69	0.1433	18797.45
1997	22474.24	0.1433	19253.68
1998	22205.99	0.1508	18857.33
1999	22112.84	0.1583	18612.38
2000	22864.68 (est.)	0.1508	19416.69

Adjusted consumption (income inequality) (C and D)

Initial ISEW developmental work in the US (and UK) sought to adjust consumption expenditure for the uneven distribution of income in a society using a Gini co-efficient approach (see Daly and Cobb, 1989, Jackson and Marks, 1994). However, later developments to the UK ISEW adjusted consumption expenditure through the application of the Atkinson index (see, Atkinson, 1983). Full details of the nature of the method used in the pilot ISEW research by Midmore et al., (2000) are found in the first phase report for CCW.

The Welsh pilot ISEW assumed that the UK correction to consumption for inequality could be equally applied to Wales. It is likely that the distribution of post-tax incomes in Wales is more even than in the UK case overall. Therefore, there is the possibility of a smaller adjustment to consumption in Wales, precisely because average incomes are lower than the UK average and there is less deviation around the Welsh mean. As indicated in the pilot, the source data for the Jackson et al., (1997) adjustment (i.e. post tax income distribution data from Goodman and Webb, 1994) was not available for Wales. At the Welsh level, post-tax

source data for an income inequality adjustment is not currently available in a publishable form. It is possible to draw some inference from regional data on pre-tax earnings from the New Earnings Survey, although this only covers employment income, which represents under 60% of total household income in the Welsh case. Developing data on the distribution of pre and post-tax incomes in Wales is a research priority noted in the current report.

The approach taken for this report, was to use the pilot index values for the consumption adjustment for 1990-1996. In order to push this series forward for 1997-2000, estimates were based on trends in the distribution of UK post-tax incomes for 1997/8 to 2000/01 from the ONS. This data, based on Gini coefficients for the distribution of income shows that the UK distribution of income widened in the period 1997/8 to 1999/00, but then narrowed slightly in 2000/01. The adjusted consumption series is found in Table B1.

Services from Domestic Labour (E)

The valuation of domestic labour services involves three main elements. An estimate of time spent on domestic labour services, an estimate of the value of this time, and an estimate of the population involved in domestic labour services.

In the pilot ISEW for Wales, the time spent undertaking domestic labour was estimated to be 15 hours per person, based on work by Gershuny and Jones (1987). A more recent study from the *British Household Panel Survey* (2001) showed that three-quarters of the housework was done by women, who spend, on average, 18.5 hours a week on household chores compared to 6 hours for the average man. This information on time spent was used to replace the previous estimate of 15 hours.

No adjustment was taken for regional differences in activity. *The Home Truths* report 2002 revealed there to be regional variations in housework, See Table E3. The table is for cleaning only but shows large regional differences in levels of activity (6hr 59mins in Scotland compared to 5hr in London). However, as the results for Wales were close to the average results, no regional activity adjustment was made.

Table E1 Regional variation in time spent cleaning

London	South East	South West	East Anglia	Midlands
5h 0m	6h 3m	5h 36m	5h 34m	6h 40m
Wales	North East	North West	Scotland	Yorkshire/Humb.
6h 4m	6h 26m	5h 49m	6h 59m	5h 57m

Source: *Home Truths Report 2002*

To estimate the value of time spent on domestic labour services, average wages of 'domestic cleaners', as reported in *New Earnings Survey (NES)*, were used (although noting this may not reflect the true opportunity cost of time – see main report). The NES data is an average for the UK, therefore an adjustment was made to reflect the lower average wage levels in Wales. The Welsh wage rate for domestic cleaners was estimated to be 90% of the UK wage level. In addition, the NES records weekly wage rates. In order to derive an hourly rate, a 40 hour week was assumed. These adjustments are shown in Table E2.

Table E2 Wage levels for domestic cleaners

Year	UK Weekly wage		UK Hourly wage		Wales hourly wage – (estimated, current prices)	
	Male	Female	Male	Female	Male	Female
1990	179.5	129.7	4.49	3.24	4.04	2.92
1991	201.6	136.8	5.04	3.42	4.54	3.08
1992	199.4	151.6	4.99	3.79	4.49	3.41
1993	195.2	163.7	4.88	4.09	4.39	3.68
1994	200.5	157.8	5.01	3.95	4.51	3.55
1995	202	161.5	5.05	4.04	4.55	3.63
1996	201.5	166.1	5.04	4.15	4.53	3.74
1997	214.1	167.9	5.35	4.2	4.82	3.78
1998	221.2	181.4	5.53	4.54	4.98	4.08
1999	229.4	183.9	5.74	4.6	5.16	4.14
2000	235.3	187.3	5.88	4.68	5.29	4.21

Source: *New Earnings Survey*.

The population able to undertake domestic labour services was kept the same as the pilot Welsh ISEW (i.e. 15-65 year olds). This information is reported in *Population Trends*

The total value of domestic labour services was then estimated by multiplying the hours worked for males and females by the hourly rate and then by the population. e.g.

$$\text{Cost} = (\text{Male hourly wage rate} * 6 * \text{population 16-65}) + (\text{Female hourly wage rate} * 18.5 * \text{population 16-65})$$

The results of this process, following conversion to £1995 are shown in Table E3.

Table E3 Services from Domestic Labour £1995

Year	Column E
1990	4403.66
1991	4450.47
1992	4572.39
1993	4678.77
1994	4540.33
1995	4517.31
1996	4474.70
1997	4476.35
1998	4639.74
1999	4645.65
2000	4725.71

Non-Defensive Public Expenditure on Health and Education (H)

Due to the unavailability of a consistent time series of information on further and higher education expenditure, the methodology adopted was to calculate the average percentage of overall education expenditure devoted to HE and FE expenditure in the UK as a whole for the period 1990-2000. (This was estimated to be 28.9%). This percentage was then applied to the overall expenditure on education in Wales (a figure that is available in the *Digest Welsh Statistics*) to arrive at an inferred figure for expenditure on HE

and FE. Public expenditure on health was taken from the Digest of Welsh Statistics. Following the pilot research and UK ISEW, half of these expenditures were assumed to be defensive.

Table H1 Non-Defensive Public Expenditure on Health and Education £1995

<i>Year</i>	<i>Column H</i>
1990	1252.48
1991	1348.06
1992	1443.92
1993	1482.69
1994	1595.79
1995	1649.95
1996	1685.72
1997	1705.04
1998	1738.67
1999	1803.39
2000	1875.00

Services from Consumer Durables Adjustment (I-F)

A proportion of consumption expenditure is on durables whose 'productive' life extends beyond a one year accounting period. For example, spending on a washing machine in 2002 creates additions to welfare in forthcoming years. Moreover, welfare in 2002 is added to by durable purchases in years prior to 2002. Therefore within the framework of an ISEW, it is necessary to estimate the flow of services arising from a net stock of consumer durables in a given period.

The UK index (Jackson *et al.*, 1997, see also Jackson and Marks, 1994) estimated the difference between spending on consumer durables and the value of the services flowing from the spending. Information is available for Wales on consumer durable spending from the Family Expenditure Survey. However, ideal data to make this adjustment to the Welsh index would also comprise detailed information on the stock of consumer durables in Wales by type, and estimates of the services flowing from this stock at various points of time.

The adjustment made to the UK index formed the basis of the adjustment made in the Welsh pilot i.e. UK differences between the spending on, and services from, consumer goods are multiplied by the share of Welsh consumer spending in that of the UK. The result is then adjusted to account for the differences between Wales and the UK in the proportion of spending on consumer durables.

Data remains a problem with this adjustment. However, improved data has become available for the UK on 'flow of services' measures of consumption (see Hamilton and Morris, 2002). Data from this research relating to the flow of services from UK stocks of consumer goods has been used to inform this adjustment for Wales. This assumes the relationship between consumption expenditures as conventionally measured, and consumption based on a flow of services measure, is the same for Wales as the UK.

Table E3 Services from Consumer Durables £1995

<i>Year</i>	<i>Column I-F</i>
1990	585.31
1991	343.54
1992	319.45
1993	363.98
1994	464.58
1995	475.71
1996	608.16
1997	765.05
1998	888.06
1999	1044.16
2000	1270.21

Defensive Private Expenditures on Health and Education (J)

The data used for this adjustment was taken from the *Family Expenditure Survey* with some additional data (total number of households) taken from the *Digest of Welsh Statistics* and the *Housing Statistics Annual*.

The categories of data included were chosen purely on the basis of a subjective choice as to their relevance to the overarching categories of 'health' and 'education'. Thus figures relating to 'medicines, prescriptions and spectacles' were included but those for 'national insurance contributions, life assurance and pension funds' were not included.

Categories of figures identified as relating to 'health' were:

- Medicines, prescriptions, spectacles
- Medical, dental, optical and nursing fees
- Medical insurance premiums

Categories of figures identified as relating to 'education' were:

- Education and training expenses

The following steps were taken to estimate relevant expenditure:

- The yearly total of household expenditure on Education and Health are totaled. This was then halved, following the UK-ISEW methodology.
- The *all Wales* weekly expenditure on Health and Education were then calculated. These are derived by multiplying the figures on household expenditure in each category by the total number of households.
- These two totals are then multiplied by 52 to give an annual expenditure. The sum of these totals gives the final yearly figure.

Table J1 Defensive Private Expenditure on Health and Education £1995

<i>Year</i>	<i>Column J</i>
1990	232.09
1991	202.72
1992	184.46
1993	206.64
1994	200.19
1995	191.25
1996	259.11
1997	265.07
1998	271.00
1999	206.24
2000	238.70

Cost of Commuting (K)

The cost was calculated by taking household expenditure on transport and apportioning this by the number of journeys attributed to commuting. In addition a value was estimated for lost leisure time as a result of commuting.

Data was taken from the *Family Expenditure Survey* on the level of spending on various modes of transport (rail, bus, car and other which includes bike, tram and motorbike, see Table K1) to provide an estimate of household spend on commuting. However, as the estimate is per household, the cost has been divided by the number of adults per household to give an approximate figure for spending per adult (assuming that most spending on transport is by adults in households).

Table K1 Commuting spending per week by households (Wales)

	Spending per week / per Household			
	<i>Rail</i>	<i>Bus</i>	<i>Other</i>	<i>Car</i>
1990	0.50	0.97	1.40	29.00
1991	0.40	0.98	1.40	31.95
1992	0.40	0.98	1.37	33.04
1993	0.48	0.91	1.81	34.13
1994	0.73	0.85	1.71	34.13
1995	0.54	0.80	2.17	33.8
1996	0.46	1.17	1.90	40.21
1997	0.49	1.18	2.30	41.00
1998	0.60	1.19	2.60	41.50
1999	0.70	1.20	3.00	42.80
2000	0.60	1.00	3.00	44.30

Source: Family Expenditure Survey (Various years)

The commuting population was estimated to be the same as the working population. In addition, it was also necessary to identify the proportion of the population traveling to work by the different modes of transport. This information was taken from *Labour Force Survey* which is reported in *Regional Trends*, Table 10.10

The proportion of spending that is attributed to commuting was approximated from the average distance (in miles) travelled per person by purpose, as reported in *Digest Welsh Statistics* (2001) (Table 10.9). This was estimated as 28% of all journeys in 1997, and this percentage was used for each year.

In summary the spending on each mode of transport per adult was calculated, based on the assumption of 1.5 adults per household. Then the working population (aged 15-65) in employment was multiplied by the proportion of people travelling to work by each mode of transport. These two figures were then multiplied together for each mode of transport. The sum of these amounts is then multiplied by the proportion of journeys attributed to commuting (28%) to give a cost per year.

In addition, the *Labour Force Survey* (Table 1.10), reports the time taken to travel to work for each region, and shows an average travel to work time in Wales of 20 minutes for 2000.

To fully estimate the costs of commuting, an opportunity cost should be included to reflect lost leisure time. Research from Department of Transport values non worker time as £4.52 per hour (1998 Pounds). This figure was then multiplied by the working population and then by time spent traveling a year. It was also assumed that people worked for an average of 48 weeks a year.

Table K2 Cost of Commuting £1995

<i>Year</i>	<i>Column K</i>
1990	1146.02
1991	1151.44
1992	1153.04
1993	1156.64
1994	1161.41
1995	1151.45
1996	1204.93
1997	1208.35
1998	1224.44
1999	1253.82
2000	1274.11

Cost of Personal Pollution Control (L)

Welsh specific data was unavailable for adjustment. The figures used were estimated by adjusting the pilot study results to reflect increases in consumer expenditure.

Table L1 Cost of Personal Pollution Control £1995

<i>Year</i>	<i>Column L</i>
1990	107.57
1991	120.57
1992	132.39
1993	141.84
1994	151.30
1995	165.48
1996	187.94
1997	192.50
1998	190.20
1999	189.40
2000	195.80

Cost of Car Accidents (M)

This cost comprises two elements, the number of accidents and a cost for each accident.

Data on the number of accidents was taken from *Digest Welsh Statistics* (Table 10.11). This gives the total number of accidents reported to the police within 30 days of the accident, and is disaggregated into 'fatal', 'serious' and 'slight' accidents. The slight category includes injuries requiring no medical treatment. Figures for all accidents including all non-injury are unavailable.

Following the pilot study, a cost for accidents, excluding medical treatment (as this is accounted for under the Defensive Health column) was taken from the work of Taylor (1990). This study estimated the non-medical costs for injury accidents at £2,596 and non-injury accidents at £871 (1990 prices).

Taylor also calculated a ratio of 8:1 for accidents involving injury and those with no injury. In an attempt to increase the accuracy of the data it was decided to use the actual number of accidents reported as Fatal/Serious for 'injury' accidents and Slight as 'non-injury' accidents (as these include those accidents where no medical treatment was needed.) This does however increase the proportion of non-injury to injury accidents from that reported by Taylor, from 12.5% to between 14% and 20% (the proportion varies from year to year).

Table M1 Cost of Car Accidents £1995

<i>Year</i>	<i>Column M</i>
1990	13.97
1991	12.60
1992	12.13
1993	11.38
1994	11.78
1995	11.39
1996	11.53
1997	11.12
1998	10.93
1999	10.74
2000	10.53

Costs of Water Pollution (N)

This column was calculated by adjusting a cost of water pollution in Wales based upon the length of Welsh rivers that were reported as being either 'Poor' or 'Bad' by the Environment Agency, (Reported in *Digest Welsh Statistics*). This was felt to be an appropriate indicator for quality, as only inland water sources are presently being used in the index.

Table N1 'Poor' and 'Bad' River lengths in Wales

	Length of river (kilometres)			Index to 1992
	Poor	Bad	Total	
1992	66.4	20.8	87.2	100.00
1993	109.5	14.4	123.9	142.09
1994	84.3	11.2	95.5	109.52
1995	71.4	6.1	77.5	88.88
1996	68.6	4.2	72.8	83.49
1997	69.8	4.2	74.0	84.86
1998	48.2	3.0	51.2	58.72
1999	45.8	9.4	55.2	63.30
2000	58.8	3.0	61.8	70.87

Source: *Digest of Welsh Statistics, 2001, Table 5.1.*

To gain a cost for water pollution in Wales information in the UK ISEW was used and apportioned to Wales based upon GDP share. (This was the same methodology used in the UK ISEW to apportion the US cost of water pollution to the UK). The cost for 1992 was used, as there was no comparable data available for river quality in Wales for (the preferred year of) 1990. In order to calculate a cost of pollution for subsequent years the cost was adjusted in proportion to the total length of rivers in Wales that were recorded as either 'Poor' or 'Bad'.

For years 1990 and 1991 the original calculations for ISEW were applied; that of apportioning UK costs to Wales based upon GDP.

These costs are consistent with those contained in the pilot ISEW, showing a general improvement in river quality (hence decreasing costs). This methodology improves on the pilot ISEW methodology which had apportioned costs to Wales based on GDP share.

An alternative method (as suggested by CCW – Water Policy Officer) would have been to use another of the Environment Agencies river classification systems i.e. River Ecosystem Score or Quality Objective. These are a very accurate measure of water quality and could provide a useful definition of pollution (that of the actual to potential score of a river). However the River Ecosystem scores are not available prior to 1995. These scores also shows a general decrease in rivers complying with their water quality target. The number of those rivers falls from 96% to 94% between 1995 and 2000. This differs to the Quality Assessment data used (for Welsh Assembly) which shows a general increase in water quality.

A potential future further adjustment to this ISEW component could include a yearly expenditure on water quality by water companies. This could be estimated by multiplying an average household water bill by the number of households in Wales, and applying the proportion of spending on environmental improvements made by water companies. In addition a report by Nautilus valued the recreational and commercial value of coastal water of Wales at £105.4 million. However the degree to which this is affected by changes in water quality needs further investigation. These adjustments have not been made as further investigation is needed into these costs.

Table N1 Cost of Water Pollution £1995

<i>Year</i>	<i>Column N</i>
1990	262.41
1991	248.23
1992	231.68
1993	329.19
1994	253.73
1995	205.91
1996	193.42
1997	196.61
1998	136.03
1999	146.66
2000	164.19

Cost of Air Pollution (O)

Following the UK ISEW methodology, the adjustment was estimated by applying a cost to each tonne of the following air pollutants produced each year.

- Sulphur dioxide
- Nitrogen oxides
- Carbon monoxide
- Volatile Organic Compounds (VOC's)
- Particulates (black smoke)

A time series of Welsh specific data is not available for these pollutants, therefore UK outputs of these pollutants were apportioned to Wales. This process was assisted by recent research undertaken by AEA Technology which details the outputs of main pollutants by each country in the UK in 1999. This was possible for all but black smoke, for which there were no direct comparison figures, therefore domestic coal outputs have been used as an indicator. This was felt to be appropriate as coal burning is the main cause of black smoke.

Table O1 Output of Pollutant by Country (tonnes)

	UK	Wales	Percentage
NOX	1604.9	84.4	5.26
Sulphur	1187.0	73.3	6.18
Carbon monoxide	4760.0	444.0	9.33
VOC	1744.0	107.7	6.18
Black smoke			9.00

These percentages were then applied to the relevant UK outputs of each pollutant to provide a data time series (see Table 3.3 of main report for selected years). The outputs of each of the major pollutants were taken from *Energy Trends*.

The marginal costs for each pollutant have been taken from the UK ISEW, which are based upon (the average of the results from) the work of Tellus (1991) and Pace (1990).

Table O2 Marginal Cost of Air Pollution (£1985/tonne)

	Tellus	Pace	Average
Sulphur dioxide	£655	£1771	£1213
Nitrogen oxides	£2836	£715	£1775.5
Carbon monoxide	£380		£380
Volatile organic compounds	£2312		£2312
Black smoke	£1745	£1038	£1391.5

To gain a total value for each year the individual pollutant costs were multiplied by the output and then summed.

Table O3 Cost of Air Pollution £1995

Year	Column O
1990	1952.83
1991	1885.71
1992	1824.17
1993	1697.61
1994	1593.73
1995	1473.91
1996	1404.73
1997	1297.20
1998	1218.67
1999	1098.75
2000	1024.14

Cost Noise Pollution (P)

Noise pollution has previously been recognised as being hard to accurately estimate. To derive this estimate information is required on noise levels and a value for noise pollution.

To achieve a time series data set, levels of activity that account for most noise pollution were collated. The following indicators were used: (these figures have the advantage of being available on a yearly basis, making future calculations easier):

- Confirmed noise complaints from domestic sources - *DEFRA*
- Road Traffic noise based on billions of vehicle kilometres – *Digest Welsh Statistics*
- Aircraft movements through Cardiff airport – *Digest Welsh Statistics*
- Road work noise – based on additional kilometres of road build per year – *Digest Welsh Statistics* (public expenditure on roads would be a more appropriate indicator of road noise than new road construction as this include road repairs. However this data could only be collected from 2001 onwards.)
- Construction – based on value of construction each year (an indication of levels of activity) - *Digest Welsh Statistics*

The changes in these factors were indexed against 1990 levels. This showed that noise levels from these various sources have all risen slightly over the ten year period with the exception of roadworks which declined steeply in the first year and remained low. This however gives no account for the geography of noise pollution and that urban/rural dwellers may have greatly differing perceptions of noise pollution.

Maddison *et al*, estimated the cost of noise pollution to be £2.3 bn for the UK in 1990. This value was used in the pilot ISEW for Wales, and in the UK ISEW.

The initial intention was to find comparable data between UK and Wales for the five sources of noise pollution described above, at a 1990 level and apportion the £2.3 billion accordingly, and then to apply the index data to this value. However, such a comparison was not possible to a satisfactory level because data on 1990 levels of activity for all the various indicators were not available. Therefore the following information was used to give a comparison between UK and Wales:

Aircraft	All airport passengers (2001)	UK	181,231,000
		Wales	1,524,000
Traffic	Billion kilometres of vehicles (1999)	UK	461.9
		Wales	15.64
Construction	Value construction output (1999)	UK	£62,858 (million)
		Wales	£2,631 (million)
Music	Domestic noise complaints (1999)	UK	31,132
		Wales	1,153
Road Works	Additional roads built (kilometres) (1999)	UK	371
		Wales	96

As far as possible 1999 was used as the comparison year as data was most readily available for this year.

These figures give an indication of the ratios of noise output between the UK and Wales, assuming that levels of activity can be used to represent the level of noise. The ratio between UK and Wales is approximately 3.5%. Ranging from 0.8% for airports to 4.5 % for construction.

Applying a figure of 3.5% to the £2.3 Billion for the UK in 1990, gives £80.5 million for Wales, slightly greater than the estimate in the pilot study (which was £67 million).

To gain a data set for Wales from 1990 to 2000 this figure (£80.5 million) was indexed to the time series data described above to give values for the years until 2000.

Table P1 Cost of Noise Pollution £1995

<i>Year</i>	<i>Column P</i>
1990	94.56
1991	95.11
1992	95.65
1993	96.19
1994	96.73
1995	97.28
1996	97.82
1997	98.36
1998	98.90
1999	99.45
2000	99.99

Costs of Loss of Natural Habitat (Q)

The statistics for the loss of natural habitat are taken from the *Countryside Survey 2000*. This survey reports habitat loss in England and Wales from 1990 to 1998 (it was assumed habitat loss was at the same rate for 1999-2000). DEFRA produced a separate set of data for Wales from the aforementioned survey, which identified change in hectareage of all major habitat types. However as this included all habitat types the natural habitats needed to be separated out. To select 'natural' habitats, those habitats listed in the UK Biodiversity Action Plan as priority habitats were used to identify the broader categories that are given in the *Countryside Survey 2000*.

These were:

- Neutral grass
- Broadleaved /mixed woodland
- Bogs
- D-shrub heath
- Acid grass
- F/marsh/swamp
- Calcareous grassland
- Inland rock
- Montane

Due to insufficient information on values for individual habitat types, the cost of habitat loss from the pilot ISEW and the UK ISEW was used (£2000 per hectare). Tir Gofal payments were identified as a possible means of applying a cost. However, these would give a figure significantly below this previous estimate, and would fail to reflect the 'true' value of the habitat, accounting for loss of income and management costs rather than a perceived habitat value. This process gave a yearly cost for loss of natural habitats of £6.451 million (in 1990 £s).

As data of habitat loss is unavailable prior to 1990, it was decided to use the number of new houses built as an indication of rate of habitat loss in Wales.

To calculate the accumulated cost for loss of habitat the loss for the period 1990 to 1998 was assumed to have remained constant since 1950. The cost of loss was calculated accumulatively from this date at the rate of £6.451 million a year.

As the habitat loss between 1950 and 1990 was an estimate based on the assumption that habitat loss had remained constant, it was felt necessary to verify this rate of decline. As urbanisation is a main cause for habitat loss, the increase in housing levels can be used as an indicator habitat loss. The data showed that over the period the increase in housing followed the overall trend of declining habitat.

Table Q1 Loss of Natural Habitat £1995

<i>Year</i>	<i>Column Q</i>
1990	312.64
1991	320.26
1992	327.89
1993	335.51
1994	343.14
1995	350.76
1996	358.39
1997	366.01
1998	373.64
1999	381.26
2000	388.89

Cost of Loss of Farmland (R)

The loss of farmland consists of two elements; loss of farmland due to urbanization and soil degradation from erosion.

The loss of agricultural land was based upon total agricultural land in Wales as reported in the Agricultural Census. The value of this land was taken as the land only value (current prices) for agricultural land in each year.

The second element of the costs is due to erosion caused by human activity. The UK ISEW used work by Evans (1993) to estimate a value of £20 million for the UK each year. In order to gain a value for Wales this cost has been applied to Wales by proportion of arable land (as this is where most erosion occurs), which averages at 10% and therefore a cost of £2 million per year for Wales. The UK ISEW also assumed a cost of £500 million for damage prior to 1950. If this is assumed to be proportional to arable land area between UK and Wales, this gives a value of £50million for soil erosion in Wales prior to 1950.

Table R1 Loss of Farmland £1995

<i>Year</i>	<i>Column R</i>
1990	169.72
1991	171.77
1992	174.18
1993	176.80
1994	179.49
1995	184.36
1996	188.76
1997	189.67
1998	191.27
1999	190.68
2000	193.54

Cost of Depletion of Natural Resources (S)

Data is available on the consumption of primary fuels by end user for the UK (Reported in *Energy Trends*). However there is no region specific information. Therefore to get a figure for Wales the main components of fuel consumption were identified: industry, traffic, domestic and other (mainly agriculture). For these categories a measure of activity was taken between UK and Wales to give a proportion for fuel consumption.

The activity indicators used were:

Industry	Turnover from manufacturing
Transport	Total number of vehicles on the road
Domestic	Household spending on fuel
Other	Number of agricultural holdings, (this may over represent Wales as it has many smaller farms)

From this data energy consumption for Wales was estimated to be 6% of the UK. (1% higher than the pilot study). Energy consumption for final users in the UK was applied to Wales, with the amount consumed per year multiplied by the replacement cost, which was £49 (1990 Prices) per barrel oil equivalent, (this was given a 3% inflationary price rise since 1950).

Table S1 Depletion of Natural Resources £1995

<i>Year</i>	<i>Column S</i>
1990	5569.23
1991	5894.75
1992	5994.14
1993	6287.93
1994	6382.66
1995	6601.35
1996	7160.53
1997	7272.73
1998	7623.03
1999	7872.13
2000	8178.37

Cost of Long Term Climate Change (T)

To improve on the pilot ISEW study additional data was used to apportion UK emissions to Wales. This was done using data from AEAT - National Atmospheric Emissions Inventory, which gives emissions by country for certain pollutants, including carbon, methane and nitrous oxides, for 1999. Estimates for Wales were then derived by assuming the Wales to UK proportions derived from the AEA Technology data were constant for the period.

The UK ISEW used information on the stock of carbon emitted, upon which a cost per tonne of pollution was applied. Information to calculate the marginal cost of each tonne of pollutant for Wales is not available. Therefore the UK ISEW costs in each year were apportioned to Wales based on the AEA Technology information for 1999.

Table T1 Cost of Long Term Climate Change £1995

<i>Year</i>	<i>Column T</i>
1990	4722.48
1991	4847.59
1992	4971.77
1993	5095.04
1994	5223.48
1995	5351.77
1996	5482.48
1997	5608.91
1998	5735.34
1999	5861.77
2000	5988.20

Cost of Ozone Depletion (U)

Information on CFC consumption is only available for the UK, neither DTI or DEFRA hold separate information for Wales. Therefore the pilot ISEW method was used of apportioning a cost to Wales from UK information (using the ratio of consumer expenditure between UK and Wales). The source for this information was the Digest of Environmental Statistics, November 2002

Table U1 Cost of Ozone Depletion £1995

<i>Year</i>	<i>Column U</i>
1990	1815.60
1991	1886.52
1992	1926.71
1993	1906.62
1994	1880.61
1995	1891.25
1996	1964.54
1997	1964.54
1998	1964.54
1999	1964.54
2000	1964.54

Net Capital Growth (V)

To estimate net capital growth, the pilot ISEW adjusted Welsh data on gross fixed capital formation by the UK ratio of net to gross investment. However the required information on gross capital formation is no longer available for Wales. Therefore the approach adopted was to update the pilot ISEW figures (for 1990-1996) for revised estimates of UK net and gross investment. For the 1997-2000 period, the average ratio of estimated Welsh to UK net investment for the 1990-1996 period (of 3.2%) was applied to the UK data. Following the pilot ISEW and the UK ISEW, the estimate adjusts for changes in the workforce, with data taken from the *Digest of Welsh Statistics*.

Table V1 Net Capital Growth £1995

<i>Year</i>	<i>Column V</i>
1990	1207.11
1991	1035.67
1992	982.52
1993	833.94
1994	847.52
1995	938.49
1996	1142.15
1997	1298.59
1998	1420.89
1999	1497.91
2000	1576.92

A new column for a future ISEW?

Volunteer time

A significant amount of time is spent by individuals undertaking voluntary work that benefits the wider community. This work effort is presently not accounted for in the index, and has not been included in previous ISEW estimates for other areas. However consideration could be given to including this information in future ISEW estimates. The voluntary work undertaken varies greatly from participation in a community play, to sitting on a committee, to "being a good neighbour". The skill levels of the volunteer are equally diverse; from St Johns Ambulance crew members to driver for a meals on wheels to a singer in a chorus line.

Wales Council for Voluntary Action (WCVA) produce yearly statistics on the value of volunteer time in Wales. The value of time is based upon average hours given by the percentage of people volunteering by the total population of Wales. The values are for formal and informal duties. Formal is for hours spent with an organisation and informal is work such as 'being a good neighbour'.

Estimated Value of Volunteer Time, £m (current £s)

<i>Year</i>	<i>Formal</i>	<i>Informal</i>
1996	£800	£1000
1999	£2000	£1400
2000	£1025	
2001	£1270	£1310

Source: Derived from Wales Council for Voluntary Action