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The *Welsh Economic Review* is produced twice yearly, by the Welsh Economy Research Unit (WERU) at Cardiff Business School. The aim of the *Review* is to provide an authoritative and objective analysis of the Welsh economy in a manner that promotes understanding and informs decision-making. The 'core' section of the *Review* is written by members of WERU, with feature articles contributed by academics or practitioners within or outside Wales. The *Review* is circulated widely within Wales, to both private and public sector organisations, including the education sector and the National Assembly.

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Authors should send papers for potential publication in the *Welsh Economic Review* to the Editor at the address given below, preferably via e-mail in a Word for Windows format. Papers are welcome on any topic that would be of general interest to the readership, and should be written in a style suitable for non-specialist readers. Papers should be approximately 3,000-4,000 words and any graphs or figures should be accompanied by the underlying data to allow reproduction.

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# Regional Environmental Input-Output Analysis for Wales

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## Introduction

In November 2000, the Welsh Assembly Government committed to promote sustainable development, under the Government of Wales Act (1998). The Assembly now has a legal duty to promote sustainable development in the exercise of its functions, providing an overarching framework for all of the Assembly's work. Part of this duty involves the setting of targets for sustainable development, and the development of indicators to assist in the evaluation of activities and policy (see Political Economy section of this *Welsh Economic Review*).

The sustainability agenda and debate in Wales has moved forward rapidly with the advent of this duty. Several (particularly public sector) institutions and organisations in Wales now incorporate 'sustainable thinking' into their working practices, and have established and/or published procedures for doing this.

The duty has also brought a number of new challenges, not least the explicit need to test new and existing policies and spending against the broad principles of sustainability, and to develop modelling tools to assess progress towards sustainability objectives. One modelling approach has been the development of pilot

environmental input-output tables for Wales. This has been undertaken by the Welsh Economy Research Unit with the assistance of the EU funded Observatory for a Sustainable Knowledge Based Region at Cardiff Business School. This article summarises the potential role of environmental input-output analysis as a tool to support regional decision making, and to more generally inform the emerging sustainable development agenda in Wales.

## Environmental Input-Output (ENVIO) Analysis

ENVIO research in Wales is still in pilot form. For illustrative purposes the results from pilot research, based on the extant Welsh 1996 input-output tables (see *Welsh Economic Review*, Vol 12.2 pp16-17) are used here to outline the potential value of the approach.

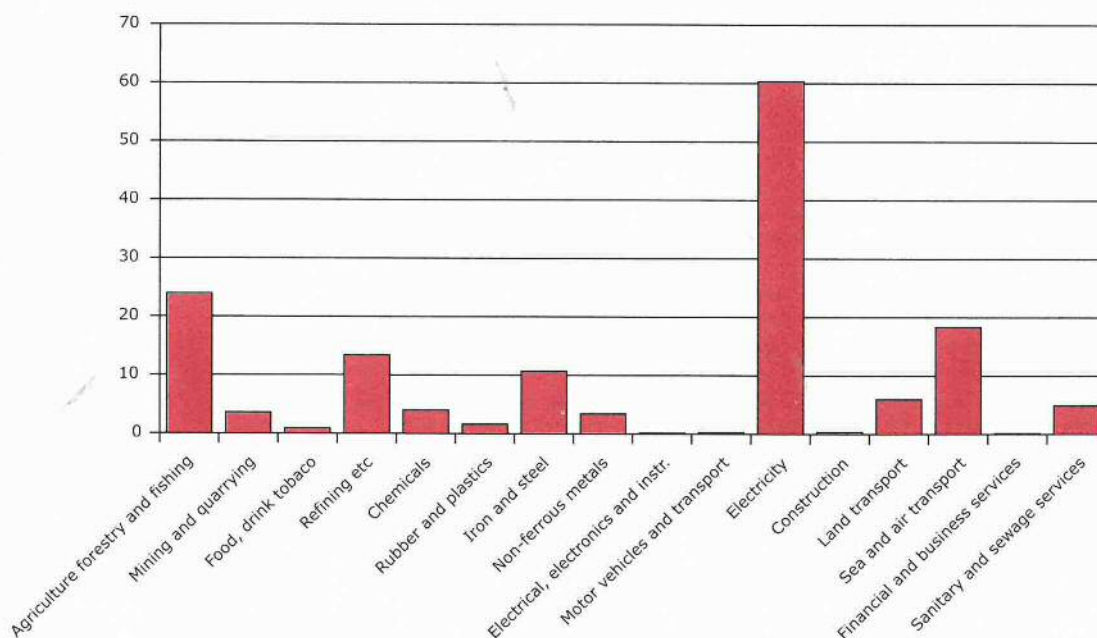
There are a number of ways in which an environmental module can be added to input-output tables. A multi-sectoral industry model of a regional economy examines the effects of economic inputs and outputs on other inputs and outputs in that economy. At a practical level this can be supplemented by a matrix of data showing the input/output of an 'environmental commodity' per unit of the industry output. This is the general approach that has been adopted in the UK. A key problem is that the input-

output tables are set up in monetary terms such that representation of the environmental sector has to be in terms of some environmental output per £m of industry output, for example, tonnes of CO<sub>2</sub> produced per £1m of output in the chemicals industry sector. With this additional information it is then possible to examine the effects of industrial output changes on a bundle of environmental factors for which output-pollutant coefficients are derived.

Research in Wales has followed such a process. Currently there is little industry level environmental data available in Wales, although better data from the Environment Agency is expected later this year. In attaching pollution coefficients to Welsh input-output tables the approach taken was as follows:

- Full use was made of UK environmental pollutants data. This was available for 123 separate industries, with pollutants disaggregated into the main greenhouse gases, acid rain precursors, and heavy metals.
- The 67 industries within the Welsh Input-Output tables were aggregated into 32 broader industry groups (for simplicity and illustrative purposes), and the physical pollution data was aggregated into the same 32 groups.
- The average UK pollution

Figure 1: Production of Acid Rain Precursors (tonnes of sulphur dioxide equivalent per £m of industry output)





**Table 1: Production of Acid Rain Precursors: Direct and Indirect Effects, Selected Industry Groups.**

Industry	Direct production of acid rain precursors per £m of ind. output (tonnes SO <sub>2</sub> equivalent)	Direct and indirect production of acid rain precursors per £m of ind. output (tonnes SO <sub>2</sub> equivalent)	Type 1 multiplier	Percentage of Welsh gross output in sector (1996)
Agriculture	23.93	27.06	1.13	1.9%
Food and drink	0.86	3.64	4.21	4.2%
Iron and steel	10.73	12.54	1.17	5.4%
Electrical and electronics	0.15	0.89	5.92	6.1%
Electricity production	60.35	61.82	1.02	2.6%
Construction	0.37	1.28	3.44	3.8%
Financial and business services	0.14	0.63	4.41	7.8%

coefficients were then used within the input-output framework to generate the direct and indirect volume of the given pollutant generated by changes in final demands in each Welsh industry.

The outputs from the above process enabled examination of Welsh industry groups that are directly associated with the larger amounts of pollutants per £m of output. These could be pollutants in terms of individual greenhouse gases (carbon dioxide, methane etc) or acid rain precursors (ammonia, sulphur dioxide etc). For illustrative purposes Figure 1 shows production of acid rain precursors (in tonnes of sulphur dioxide equivalent) for the 32 industry groups. Industries producing the highest levels of acid rain precursors **per £1m** of output include agriculture, refining, iron and steel, electricity production, and transport. However, the significance of the input-output framework is that it allows one industry's production to be linked with another industry's pollution creation in Wales.

Table 1 shows, for selected industry groups, the direct **and indirect** acid rain precursors produced per £1m of industry output. The table illustrates that some industries, whilst not directly producing high levels of pollutants, may support the production of externalities further along the supply chain in Wales. For example, every £1m of output in the food and drink industry group in Wales produces an estimated average of 0.86 tonnes of sulphur dioxide equivalent directly, but supports activity in the region which produces a total of 3.64 tonnes of sulphur dioxide equivalent. The multipliers in this instance may provide useful information to regional policymakers demonstrating how

activity in one sector can be linked to externalities created in others.

Care has to be taken, with for example, the multiplier giving little indication of the importance of an industry in the Welsh economy, such that a large multiplier may be connected to an industry that is almost insignificant to the region. Hence other information, such as that given in the final column of table 1, would also be required. Moreover, this type of analysis at the regional level focuses on pollutants directly and indirectly produced in the region. The magnitude of indirect effects is then tightly related to the import propensities of the selected industry groups, such that significant pollution elsewhere in the UK and abroad may be indirectly associated with Welsh-based industrial activity, although this may be estimated by reference to regional import matrices.

### ENVIO – wider applicability

The ENVIO approach benefits from being reconcilable to national and regional accounting systems, and other frameworks such as the environmental satellite accounts where they exist. The regional ENVIO approach could also be an effective way to inform strategies relating to the economy, and waste and natural resource management. The outputs of policy simulations using ENVIO could potentially be used as 'inputs' to predict possible wider outcomes on other sustainable development indicators or tools. However, typical ENVIO analysis in the UK is as yet only able to estimate the effect of the economy on some aspects of the environment. The potential feedback effects from the environment to the economy, or the interactions between environmental variables are

not incorporated within such analysis.

A developed ENVIO approach could provide the Welsh Assembly Government, regional development agencies and the Environment Agency with a tool which will allow economic growth and resource productivity scenarios to be linked to a limited set of key environmental pressures.

### Selected References

ECOTEC (2001). *Welsh and regional economies' resource productivity*. Environment Agency: Bristol.

NAFW (2001). *Learning to Live Differently - The Sustainable Development Scheme of the National Assembly for Wales*. NAFW: Cardiff.

UK National Accounts (2001). *UK Environmental Accounts 2001*, published as Part 5 of the Blue Book, 2001.

More information about the Observatory for a Sustainable Knowledge Based Region (OSKaR), which is one part of the TASK programme, can be found at [www.sustainableregions.net](http://www.sustainableregions.net)