**CASE STUDY:** The Energy and Environmental Prediction (EEP) model

SECTOR: Assessment
COUNTRY: U.K.

BACKGROUND
The Energy and Environmental Prediction model is a computer based model that provides an auditing tool for quantifying energy use and associated emissions for cities to help plan to reduce carbon dioxide and other emissions. Development of the model has been funded by the UK Engineering and Physical Sciences Research Council (EPSRC) since October 1994.
The EEP model is based on Geographic Information System (GIS) techniques and incorporates a number of sub-models to establish current energy use and CO_2 emissions produced by buildings, traffic and industrial processes for a city. The model can predict the effects of future planning decisions from a whole city level down to a more local level. The user can identify 'hotspots' of energy use and emissions that can be targeted to make environmental improvements.

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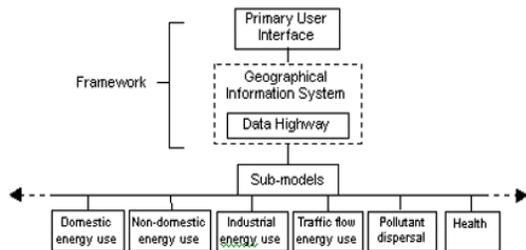
The EEP model comprises four sub-models that predict energy use and emissions:
The domestic sub-model uses built form and age to group properties into 100 different types. Each type has an associated CO_2 emission, SAP rating and yearly energy cost associated with it. Every property within the region is surveyed and classified as a 'type'. Predictions can be made of potential CO_2 and energy savings that can be made by installing various energy efficiency measures into properties.
The non-domestic sub-model provides energy use figures for 48 different types of commercial property. Floor area and type of property are used to predict annual energy use and CO_2 emissions for every property.
The industrial sub-model predicts annual energy use and CO_2 emissions for sixteen different industrial sectors using output figures from industries.
 Spatial Analysis procedures are used within the traffic sub-model to predict energy use and

emissions from traffic flow on every road within a region.
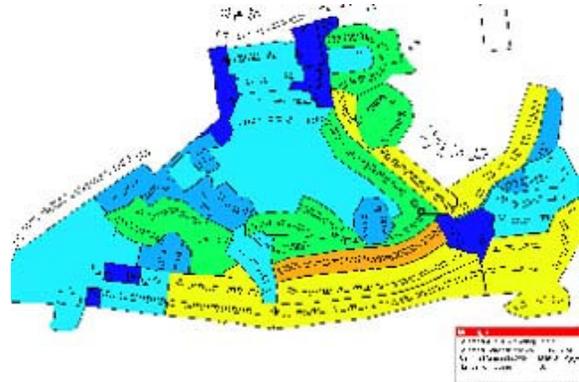
INDICATORS
Energy use
CO_2 Emissions
SAP rating
Vehicle flow per hour
Vehicular emissions

EVALUATION
Data for the model is collected from a variety of sources including desktop sources, historical records and 'drive by' surveys. The EEP model acts as a database to store property based information that is collected. Information stored within the model has been validated against detailed information obtained from the local authority. Detailed SAP ratings have been obtained from local authorities and these have been compared to results.

Built form	Age of prop	Council SAP rating	WSA SAP rating	Difference
end ter	1919 - 1944	44	60	16
mid ter	pre 1919	45	62	17
mid ter	pre 1919	45	65	20
mid ter	pre 1919	45	65	20
mid ter	pre 1919	48	61	13
end ter	1919 - 1944	48	60	12
mid ter	pre 1919	55	65	10
mid ter	pre 1919	61	61	0
end ter	post 1980	63	58	5
mid ter	pre 1919	72	68	4
				11.7

The traffic sub-model produces a map that indicates the relative flow rates on every road within a city. Further developments are underway to correlate integration values calculated by the model with real traffic flow data provided by the local authority.

Average traffic flow per hour against global integration value

$R^2 = 0.6495$
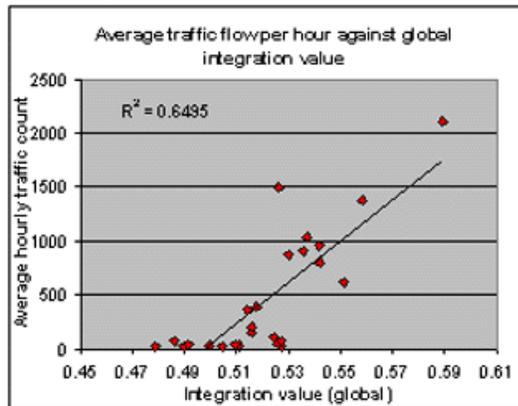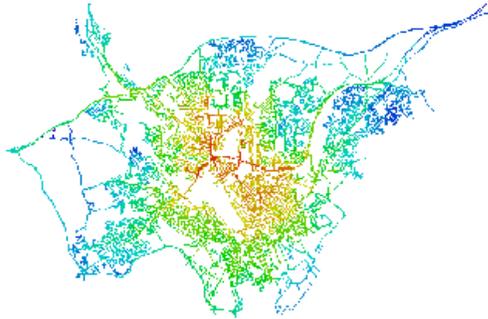
Each of the sub-models apart from the traffic sub-model use UK Government Accepted Procedures to predict energy use. The EEP model is specific at present.

Development of the EEP model began in Cardiff University in October 1994 when funding enabled the development of the framework and the domestic, non-domestic, industrial process and traffic sub-models. Further funding was obtained in 1998 to develop the model with additional partners from DeMontfort University, Leicester, University College, London and Queens University, Belfast to incorporate air pollution dispersal and health sub-models and also to look at the implementation of the model into the local authority workplace. This work is due to be completed in February 2001. It is hoped that the EEP model will continue to be developed to incorporate further sub-models to provide a more holistic prediction tool.

Neath Port Talbot County Borough Council is the first local authority area where the EEP model is being applied fully. The area comprises approximately 60,000 domestic properties, 4,000 non-domestic properties. To collect and input the required data for the area will take approximately 15 person months (due for completion in September 2000).

Throughout the development of the model it has been identified that to be able to plan and predict energy use to a high degree of accuracy a large amount of detailed information is required. A technique has therefore been designed that enables relevant data to be collected through unobtrusive surveys relatively quickly and easily. A number of assumptions therefore have to be made to be able to make these predictions that are not true for every property but provide an overview of what is the most typical.

Data has to be collated into areas to enable representation on a city wide basis. If these areas are too large detail can be lost through too much variation and if data is represented for every property information can be overwhelming. Properties are therefore grouped into small areas of between 10 - 100.

TRANSFERABILITY

The EEP model has been designed to be transferable to any city in the world. It was initially developed in Cardiff (Wales) and is currently being applied to Camden (England), Leicester (England) and Belfast (Northern Ireland) under the EPSRC research grant. Neath Port Talbot County Borough Council (Wales) have funded Cardiff University to apply the model to the entire local authority region The model has also been applied to a demonstration area of Newcastle, Australia in collaboration with the local authority.

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