

Sim cities

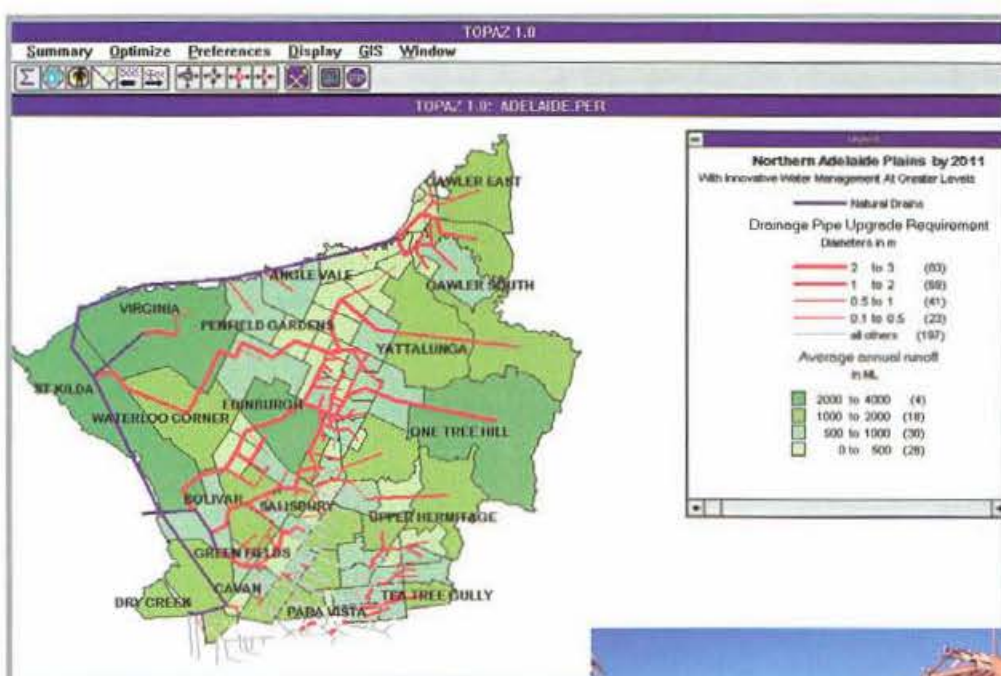
Increasing the urban sprawl of Australian cities, if carefully planned, actually could reduce greenhouse gas emissions. No, there's no mistake, say urban modellers Dr John Roy and Dr Leorey Marquez from CSIRO's Division of Building, Construction and Engineering. This is the kind of unexpected conclusion that computer simulations of cities can provide.

High-density cities reliant on public transport have the lowest greenhouse gas emissions. But according to Roy and Marquez, changing Australia's relatively young, low-density cities to fit this model could not be achieved in time to reach greenhouse gas reduction targets (a 20% reduction by 2005).

An alternative strategy is to move employment and facilities nearer to people living in outer suburbs, and to encourage home-based work by making private transport costly. In the end, this should create higher-density outer suburbs which are only marginally less energy efficient than a more compact city.

The researchers were guided to this conclusion by a computer model they built called SUSTAIN (Sustainable Urban Structure and Interaction Networks). The model is an educational tool which shows how an idealised, radially-symmetrical city reacts to the forces that shape it.

'SUSTAIN Mark I shows how a city might respond to changes in its basic characteristics,' Roy says. 'Some factors, such as growth rate, are beyond the direct control of urban planners; others, such as fuel and road pricing, can be controlled.



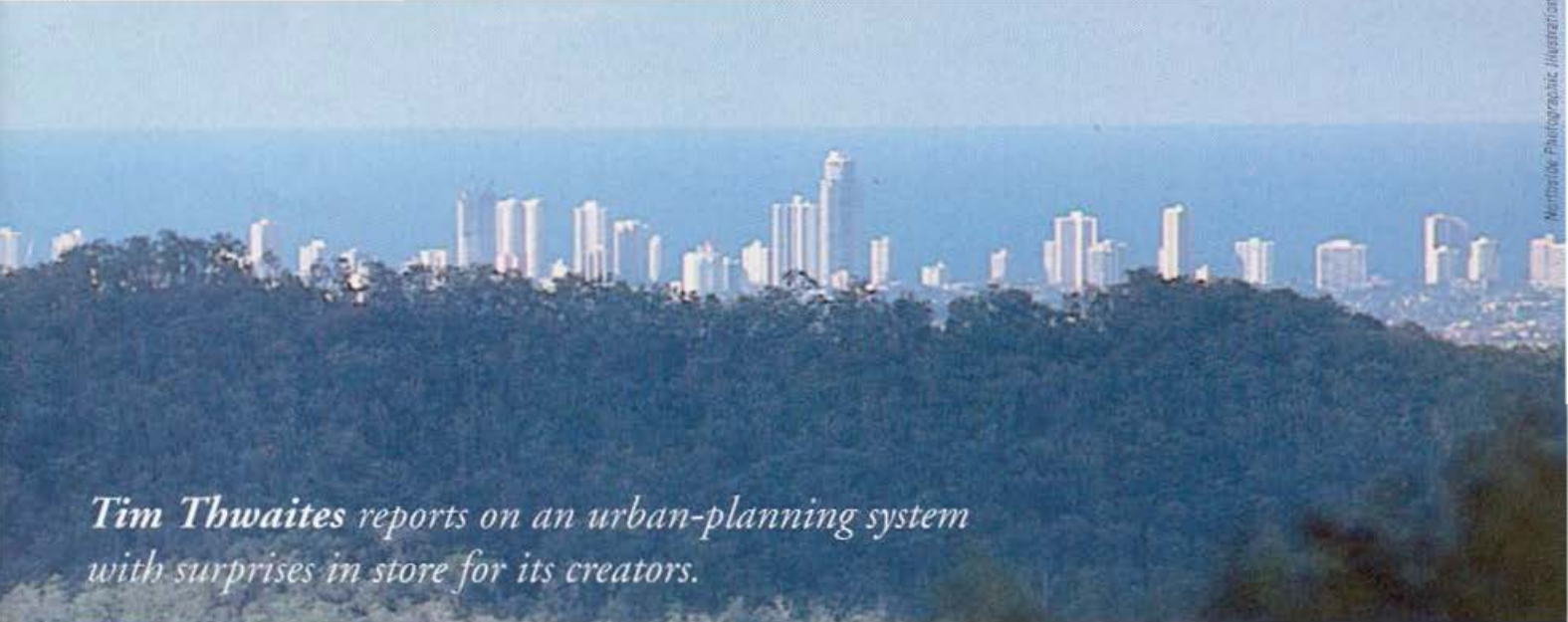
We can use the model to determine policy combinations which fit together to produce a desired result.'

A newer version of the model, SUSTAIN Mark II, enables a more realistic simulation of individual cities, incorporating major and minor roads, job centres and residential areas. It is no longer constrained to radial symmetry, and can act as a preliminary design tool for actual cities.

In another urban-planning project, Dr Jacek Gibert and Dr Shiroma Maheepala used a computer model called TOPAZ-SUCO to explore water-management options in northern Adelaide. They found that by integrating water supply and drainage, and by using and re-using water efficiently, local utilities could delay by up to four years the construction of a \$500



A study in northern Adelaide found that by integrating water supply and drainage, and using and re-using water efficiently, local utilities could delay by up to four years the construction of a \$500 million pipeline to the Murray River.



Tim Thwaites reports on an urban-planning system with surprises in store for its creators.

CSIRO's urban modelling framework has been used to help plan efficient public transport links between Brisbane and the Gold Coast.

million pipeline to the Murray River. This would save money and reduce strain on the Murray River.

The TOPAZ (Technique for Optimal Placement of Activities in Zones) model differs from SUSTAIN in that it focuses on maximising or minimising some critical facet of the urban system. Instead of exploring alternatives based on different scenarios, TOPAZ models the existing conditions, and shows how best to change them to achieve a desired result. For example, it can help determine where to locate new employment so that travel costs are minimised.

When SUSTAIN and TOPAZ are combined, problems such as how to develop efficient public transport links between Brisbane and the Gold Coast can be tackled. The models also can be used to project land-use patterns and evaluate their consequences for transport, or for the provision of utilities such as water systems, telephone cables, gas and electricity supply. Solutions can be displayed in map form using geographical information systems software.

The planning issues outlined above illustrate the power of modelling to help design sustainable urban systems, a need which is becoming increasingly important as the environmental impact of our cities expands.

Cities that are environmentally and economically sustainable have well-located facilities and efficient utilities, telecommunications and transport systems. Developing computer models to help plan such cities has been a focus of research for Dr John Brothie, Roy, Marquez and others at the division for almost 25 years. They have assembled a library of flexible

software components that can be reused in decision-support systems suited to range of needs (such as SUSTAIN and TOPAZ). The library is called AUDIT (Appraisal of Urban Development, Infrastructure and Transport).

As well as being applied in Australia, the AUDIT models are contributing to a major project with the Indonesian Ministry of Public Works which is planning the future of several cities in Java. The first target is Bandung, a city of about three million people on the northern coast, east of Jakarta. The three-year project aims to develop transport models for Bandung, and at the same time train Indonesians to use the modelling software. Major outcomes will include an Indonesian version of the software and an advisory report with recommendations about such matters as road and rail developments.

Marquez says caution is needed when applying the Australian programs in Indonesia and other South-east Asian countries. 'We have found that many of the assumptions we use in Australia simply do not apply in Indonesia,' he says. 'For example, in Australia you can assume that

most drivers will use the main highways to travel between two points, so you primarily need to model major roads. In Indonesia the back roads carry just as much traffic as the highways, and there's a different variety of vehicles and land uses. So the Australian models must be calibrated and modified to reflect local conditions.'

But already the group has been successful enough to contemplate plans to take on the big one: Jakarta, a city which will grow to 40 million people in the next 20 years. This will necessitate another modelling change. 'The values involved are a couple of orders of magnitude higher than those our models are accustomed to handling,' Marquez says.



The modelling team has embarked on a three-year project to plan several cities in Java, Indonesia. A future challenge may be Jakarta, a city destined to grow by 40 million people in the next 20 years.

