25th Australasian Transport Research Forum
Incorporating the BTRE Transport Policy Colloquium
Canberra 2-4 October 2002

Futures planning: a systemic approach

Carlos Rodriguez
RMIT University

Abstract

A major challenge that Australia is facing at all levels of government, like many other countries, is the need for an improved understanding of the planning process, and thus increasing the chances of achieving more sustainable environments. In order to attain this kind of development, changes should be made in several key areas; these changes need to be supported by a clear vision of the future which reflects a better perception of the different systems that support this vision.

This paper explores the relevant literature and reviews the potential for the combined use of Backcasting and Strategic Environmental Assessment in the achievement of the vision. A framework is proposed which integrates these two concepts: Backcasting, which involves working backwards from a desirable future, and Strategic Environmental Assessment (SEA), which represents a complementary tool for considering environmental impacts at strategic levels. This framework, based on the concept of "systems", is presented as an alternative to supplement the planning process at a strategic level.

Contact author

Carlos Rodriguez
PhD Candidate
Transport Research Centre
Business Faculty
RMIT University

Phone 9925 1320

Fax: 9925 1313

Email: Carlos_rodriguez_98@yahoo.com

GO BACK TO START SCREEN GO BACK TO INDEX

Introduction

The increasing awareness of the environment that society has been showing over the last few decades and the way problems should be solved towards this end has led to the creation of a number of frameworks, concepts and tools for sustainable development (SD) and sustainability.

Sustainability is "a process of change in which the exploitation of resources, the direction of investments, the orientation of technological development and institutional changes are made consistent with future as well as present needs" (WCED, 1987); or the moment in time when the ecosphere has the ability to sustain an equilibrium between ecosystems and society with its demands for services and resources from the ecosphere (Robert, 2000). Non-sustainability means a systematic degradation of this ability. On the other hand the Brundtland report (WCED, 1987) defines sustainable development as the ability to meet the needs of the present without compromising the ability of future generations to meet their own needs.

Both concepts refer to a system but at different levels. Sustainability, being the *outcome*, encompasses a *process*, sustainable development. In both cases they refer to the ecosphere[1], a highly complex system.

This paper sketches a conceptual *framework*, based on the systems concept, for a method for analysis of sustainable development issues by combining a *tool*, Strategic Environmental Assessment (SEA), with an *approach*, Backcasting. Firstly, the systems approach is explained, being the starting point of the framework; secondly, SEA and Backcasting are described in order to illustrate the role they have in the framework; and finally, an example of the need for this framework is specified.

Can a planning problem be understood as a system?

In this section is useful to be aware of the difference between a system and a systemic approach. A system is an integrated whole whose essential properties cannot be determined from the properties of the elements (Arnold and Osorio, 1998), for example a city or a transport system. They are characterized by the relationship of its parts, which keep the system united in aiming for an objective (teleology).

A *systemic approach* is a way of interpreting reality as a system, understanding that it has subsystems that interrelate with each other and hence allow the explanation of phenomena and its future behaviour (Barrera, 2000).

When analysing reality, the explanation of the phenomena will be determined by the way elements or subsystems interconnect. Explanations such as Reductionism presuppose that effects on higher hierarchical system levels can

[1] Ecosphere — the biosphere plus the whole atmosphere with its ozone layer. Holmberg, J. and Robert, K.-H. (2000) *International Journal for Sustainable Development and World Ecology*, **7**.

be reduced to lower hierarchical system levels, implying that the cause-effect chain goes one way, while in reality complex systems can have all kinds of causal relationships going into more than one direction (Rotmans, 1999). Thus, Reductionism has been not particularly successful, opening the way for Systems Thinking to produce an approach which will encompass the "whole"

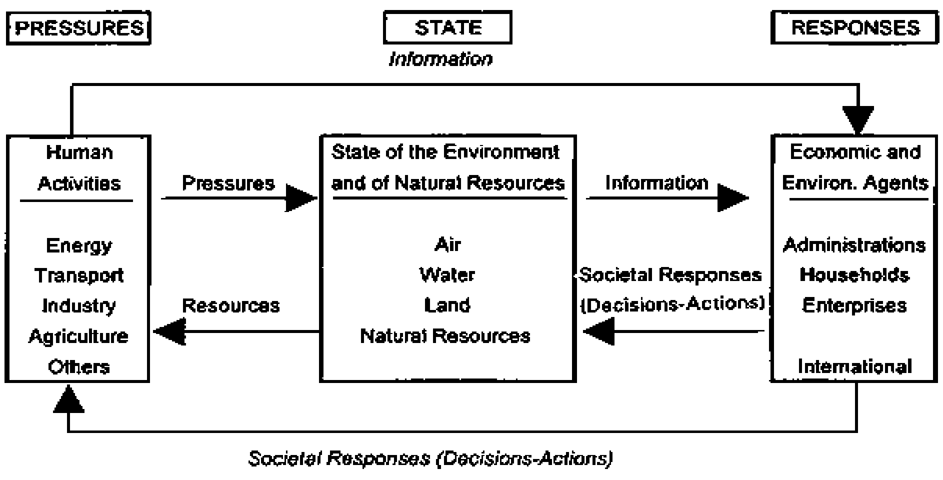
When planning for sustainable development, systems thinking should be integrated in order to expand and include all the relationships that could affect the outcome (sustainability) of the process. Once all the parts are in the picture, trying to fit them together in such a way that a logical whole arises is the essence.

Problems in planning arise when:

- All relevant variables are not included
- When the magnitude of the variables are incorrect
- When the time for the expected impact is mistaken

In a system these three issues can be seen in terms of: a) the elements of the system and b) the relationship within the elements. An example of how a problem can be analysed as a system is the Pressure-State-Response (PSR) model from the OECD[2] (Figure 1). This kind of system (model), based on causality, describes the way humans interact with their surrounding space. This interaction causes an impact, called a *pressure*; this impact changes the *state* of the environment; and what society does, for example in terms of policies to overcome the impact, is called *response* (Newton, 1998).

Figure 1. The Pressure-State-Response model



Source: OECD (1993)

---

[2] OECD (1993) OECD, Paris, pp. 35.

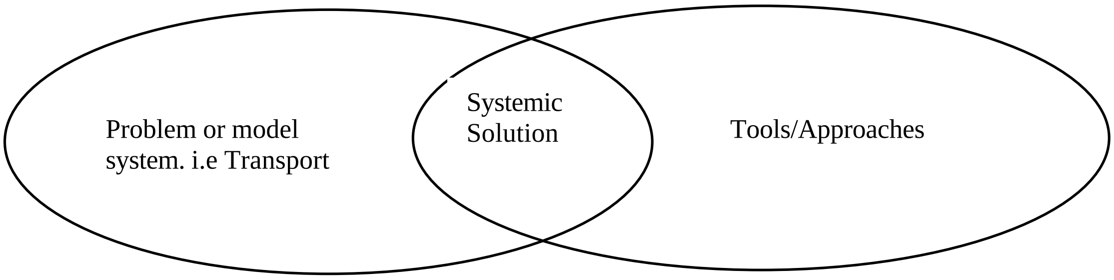
Using this model as an example of a systemic approach let us represent a current problem. Climate change (*state*) is caused by a high demand for energy, food and land. The reason behind this growing demand is population and economic growth, and changes in lifestyle (*pressure*). This puts stress on the environment in such a way that the state or condition of the atmosphere and biosphere is changed; hence major social impacts in agriculture, water management, and health care are experienced. This means society has to develop some class of intervention or *response* (i.e. fuel tax, clean technology subsidy, etc) designed to react to the new *status quo,* in order to restore the initial conditions of the system.

Is this approach enough to solve the system problems? Are all the variables included? Surely not, meaning the “solution” would be just a weak attempt of tackling the problem. Possible solutions can include increasing the numbers of impacts listed, trying more policies, maybe changing the time frame for the expected results of the various policies, and many more. This shows that even a systems approach has its limitations and it has to be complemented to achieve a more realistic solution.

This does not entail making the problem even more difficult to solve, but understanding or “reading” the problem in such a way that additional solutions can appear (see Figure 2). Maybe employing tools that are being used already for different problems, and with a potential to be linked and used in a way where an alternative approach will clarify the path to reach a sustainable outcome (Robert et al., 2002).

So far a problem has been looked at as a system, showing advantages over approaches such as Reductionism. The paper will attempt to show that in order to solve a planning problem, even the tools selected to tackle it need to be used within a systemic approach, where time will be a necessary ingredient for conception. This will give planners or politicians knowledge about the consequence of solutions in time (forecasting), or if a teleological approach is to be used, then the best path to get to a desirable vision (Backcasting).

Figure 2. A systemic solution



Several concepts and tools for achieving a more sustainable future have been developed. These include environmental impact assessment (EIA), strategic environmental assessment (SEA), life cycle assessment (LCA), cost-benefit analysis (CBA), Backcasting, ecological footprint (EF), Factor X, risk assessment (RA) and The Natural Step Framework (TNS), amongst others. These have been developed within separate disciplines and for somewhat different purposes, but are contained by the concept of environmental systems analysis.

This variety has led to some confusion regarding the qualities, differences and linkages between them, and hence the way of applying them.

For comprehensive planning in any complex system, these tools and approaches can be delineated in five hierarchically different system-levels (Robert, 2000):

a) Principles of the constitution of the system (e.g. ecological and social principles). This level represents the overarching system that we are focusing on, the ecosphere;

b) Principles for the outcome (sustainability). This level represents the goal;

c) Principles for the process (sustainable development). Focuses on the way of reaching the goal, how to move society towards sustainability, i.e. Backcasting, Dialogue and Legislation;

d) Actions (concrete measures), for example recycling; and

e) Tools, which should be designed from a systems perspective to indicate and audit progress towards sustainability, i.e. SEA, EIA and Factor X

These five principles represent a system itself; a system that can fit the more specialized concept or tool (level 5); or a system that can handle the most complex system (level 1). When the model is applied, the problem being considered should be able to be represented, placed or distributed in any of the elements (levels) in the model. A problem doesn’t have to be in all the levels (it can be in one level), but it needs to comply with the characteristics (principles) above or below in the hierarchy (see Figure 3).

The reason why The Natural Step framework (level 2 and 3) is specified in the figure relates to the nature of the process that it uses to aim for Sustainability, namely Backcasting. SEA on the other hand represents level 5, the tools; and since strategic environmental assessment is an analysis that can be based on past trends, for the purpose of this paper we will assume it can work as a forecasting tool. Ideally, combining forecasting and Backcasting could obtain the optimal results in a strategic planning process. In other words, forecasting doesn’t provide a clear north (aim), and Backcasting ignores the trends that determine realistic day-to-day measures (Hast et al., 2000).

Figure 3. The five levels of the General Model

1. Principles of Ecosphere (Social and Ecological constitution)
2. System Conditions (Principles of Sustainability)
3. Strategy (Principles for Sustainable Development)
4. Activities
5. Concepts and tools

Negative effects in Nature

TNS framework (levels 2–3)

SEA (level 5)

Source: Adapted from Robert, K.H. (2000)

SEA and its role in the systemic approach

This section will concentrate on explaining the concept and advantages of the tool, and a proposal of its usefulness in a system.

Strategic environmental assessment can be described as a systematic procedure for integrating environmental considerations into strategic decision-making processes such as the formulation of policies, plans and programs (Therivel et al., 1995).

Although SEA currently is found in many forms, they all have the same rationale. The early 1990's witnessed a growing recognition that traditional environmental impact assessment (EIA) at the project level could not adequately address and influence issues that had been decided at an earlier stage and at more strategic levels. As a result, environmental assessment of policies, plans and programs in addition to projects was advocated. Since then, different approaches to SEA has evolved, ranging from providing decision makers with an environmental report at a given stage, to letting the SEA act as a framework to guide the whole decision-making process. Nowadays it is considered a more flexible indicative framework, mainly influencing decision making rather than a formal administrative step-by-step procedure (Partidario, 2000).

In transport, SEA is particularly useful for example in assisting decisions on a multi-modal approach. It helps to structure and focus environmental analysis on the key environmental benefits and costs of each transport mode, by comparing alternative planning and management options in an integrated way and providing decision-makers with the relevant information to enable them to take the most sustainable decision.

Some useful advantages of SEA that are relevant to the transport sector are:

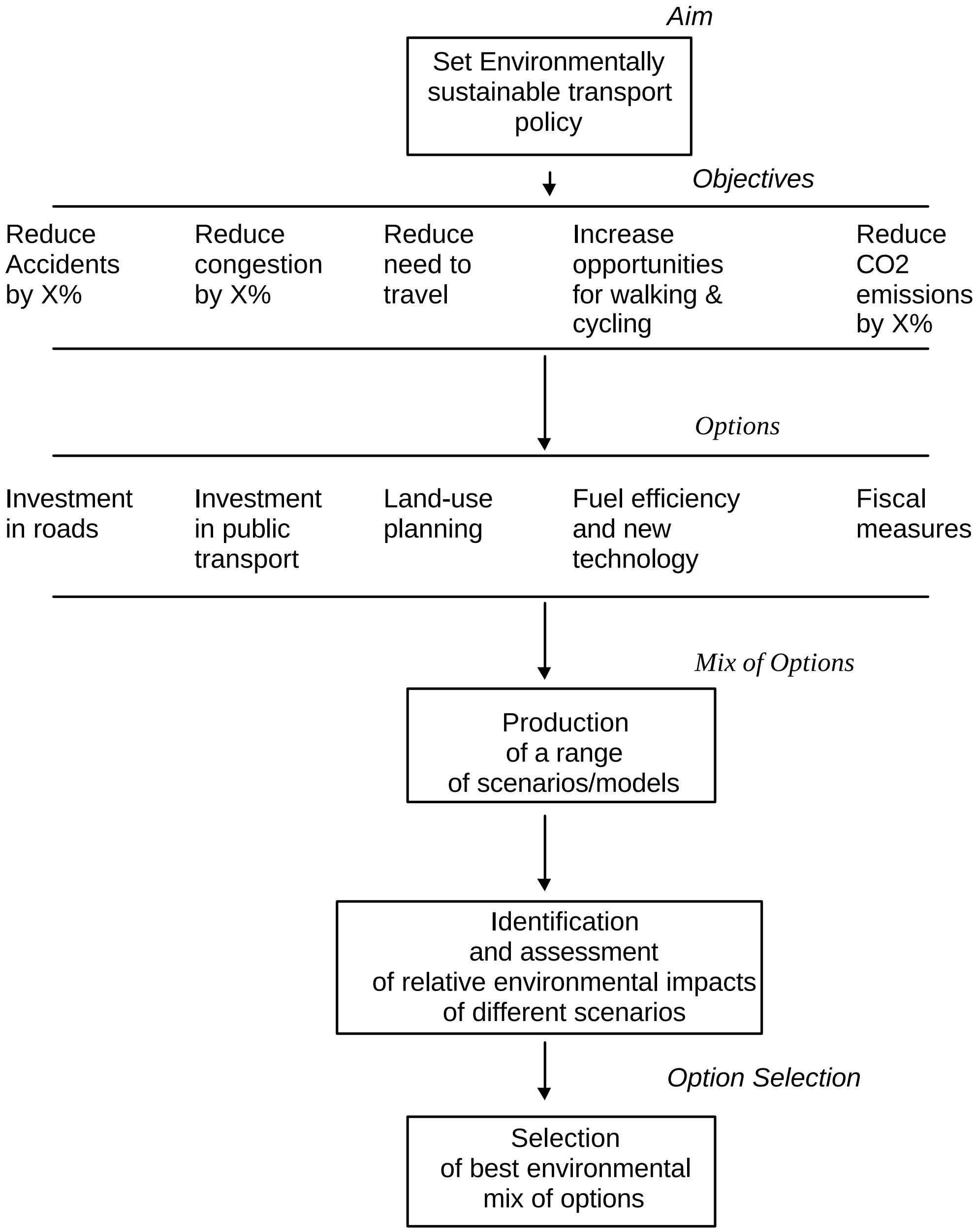
- Wider consideration of impacts (cumulative impacts, e.g. emissions) and alternatives;
- Pro-active assessment in policy, plan and program;
- Strengthening project Environmental Impact Assessment;
- Systematic and effective consideration of the environment at higher levels of decision making;
- Public participation.

Some of these characteristics are related to time, such as the consideration of cumulative impacts or the proactive assessment of policies, plans and programs; in general SEA is a tool where time plays a significant role due to its strategic nature. Therefore thinking about the future using SEA is sensible. Constructing environmental scenarios (future forecasting) in order to develop planning and policy-making is an important element of the SEA "tool box" (Dalal-Clayton and Sadler, 1998), which is one of the parts (subsystems) of the Proposed Strategic Model of this paper.

As an example, Sheate (1992) developed the following flow diagram (see Figure 4), applied to the Transport Sector.

The SEA methodology applied in this particular exercise involves identifying the policy sustainability or environmentally objectives; linking these objectives to indicators; and using the indicators to test the attainment of the objectives, describe the baseline environment, make impact predictions of different scenarios, and select the "best" scenario or mix of options.

Figure 4. SEA in the transport sector



Source: (Sheate, 1992)

Backcasting and its role in the systemic approach

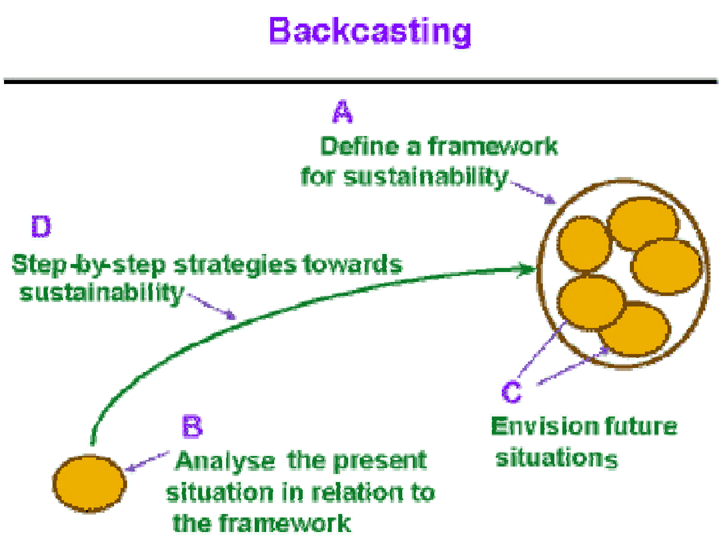
In the previous section the first subsystem, SEA, was described as a tool that will allow us to move from a present point in time to the future, the *business as usual scenario*. Now, Backcasting will be described as the other half of the system that will bring us from future to present time in order to illustrate the way desired future scenarios can be attained (Dreborg, 1996). Thus the process will close the loop within a systemic approach. Planners and decision makers will be able to analyze and study how far or close they are from a "sustainable" starting point, giving new insights into the planning process.

A commonly used approach in strategic planning is The Natural Step framework. The main characteristic is the way it aims for sustainability, using Backcasting. It is based on the idea that it is possible to define basic principles of the future even if it is not possible to describe the sustainable future in detail. The framework has two elements, first of all the system conditions describing the future sustainable situation (level 1 of the general model stated in Figure 3), and secondly a Backcasting approach to develop alternatives towards sustainability (levels 2 and 3 of the same model).

Backcasting can be represented in four steps (A-D) illustrated in Figure 5. The steps of the framework are: (A) share and discuss the model within the system conditions; (B) analyze the present situation, the critical flows with reference to system conditions (what are we doing well or what needs to change?); (C) envision future situations, and list the possibilities for providing the same services without violating the system conditions and; (D) design the strategies for transition (Kuisma, 2000, Robert, 2000).

The Natural Step framework is useful for raising awareness and for communicating a relevant understanding of what must be done in principle, but cannot be applied "hands on", for instance as "metrics". However, basic principles for sustainability and for sustainable development are essential as guidelines when metrics are to be determined and/or elaborated for a given activity, or process. In the next section we will see how the tool SEA (the first subsystem), can be complemented with Backcasting, the approach (and second subsystem).

Figure 5. The Backcasting approach



Source:(TNS, 2000)

Backcasting, like SEA, has its own niche of applicability; according to Dreborg (1996) this approach can be used when:

- The problem to be studied is complex, affecting different sectors and levels of society;
- There is a need for a major change;
- Past trends are part of the problem;
- Externalities play a relevant role in the problem; and
- When the time horizon is long enough for deliberate choice.

Omission or misreading of some of these characteristics in the planning process leaves gaps which are unsustainable in the long run. The benefits for planning of the TNS approach are twofold. The first one helps problem solving at the source because any solution has to follow the principles of sustainability; and the second advantage is that it launches a goal-oriented planning system, Backcasting.

It is clear how this subsystem has an opposite perspective to SEA, referring to the *input* information. SEA uses past trends to define its vision while Backcasting uses desirable and interesting visions of the future with no obvious link between past trends and future trends (Dreborg, 1996).

Some common aspects between the tool (first subsystem), and the approach (second subsystem), are how they both refer to complex systems, higher levels of decision-making and long term time frames. This feature increases the feasibility of linking them under the same framework.

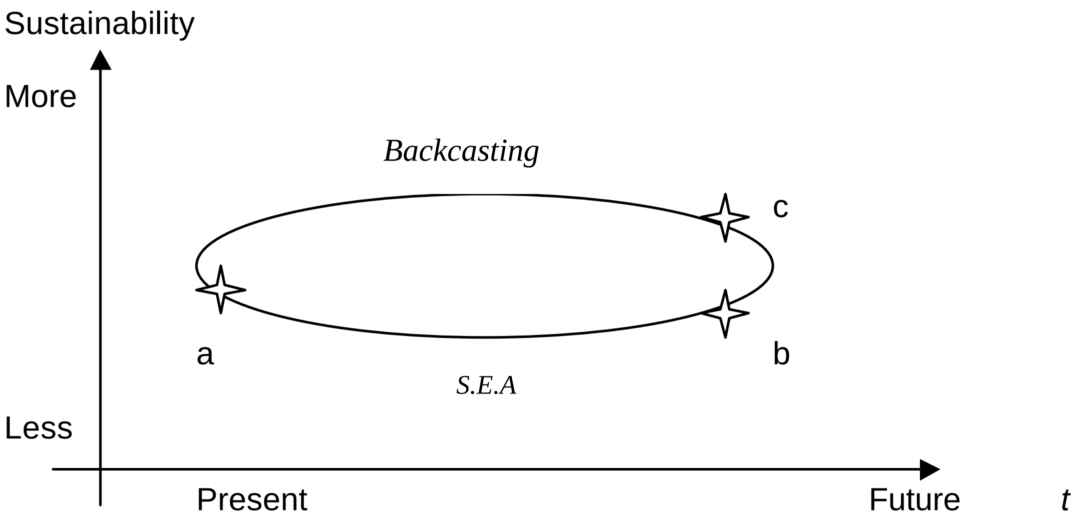
The proposed strategic model

So far two subsystems have been described, SEA and Backcasting. Both of them are parts of the same system, the General Model (Figure 3), but they represent a different level. This gives sufficient scope for a new application of the systems approach, in order to show that these levels are complementary (together they can make a “whole”) and can be used for strategic sustainable development (Robert et al., 2002).

If these two subsystems were to be integrated (see Figure 6), the design will represent a system; where *a*, *b* and *c* correspond to the characteristics of each subsystem in time. This is what may be termed, in this paper, as a “systemic solution” (see Figure 2). Idea which has the potential to supplement the common analysis done to a system (i.e. the transport system), with the tools and approaches that best fit the analysis.

Previous research has demonstrated that Strategic Environmental Assessment and Backcasting can be organized as a system to achieve sustainability. Guhnemann (1999), used SEA as an assessment tool to help set the vision of the future, while Backcasting was used to take into account global and long term environmental impacts.

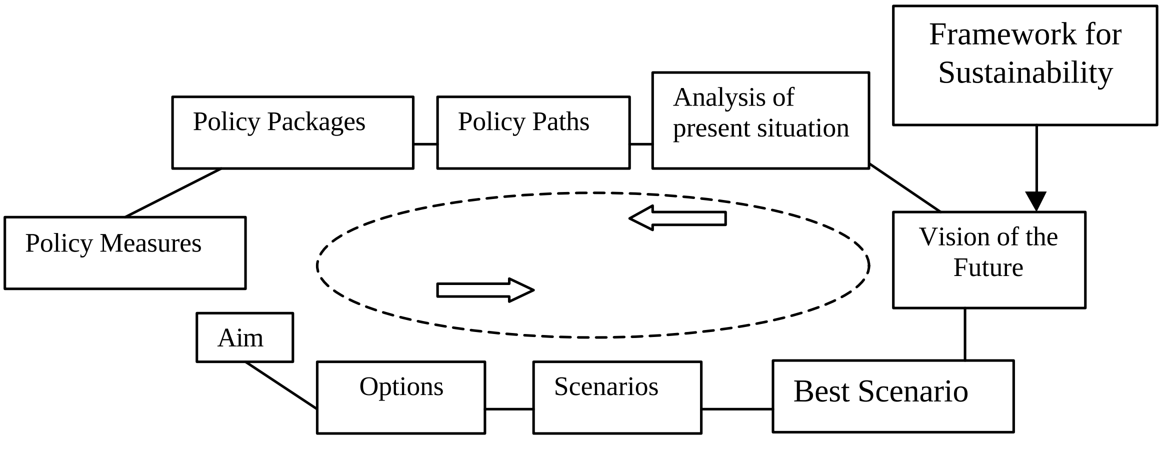
Figure 6. Strategic systemic approach



Note. Where (a) is "Present Time", (b) is the "Business as Usual" scenario, (c) is the "Desirable-achievable future".

Another way of expressing this combination is presented in Figure 7, where the systemic approach is described in a more functional mode. The idea of the behind this interpretation is the same as in Figure 6: SEA will forecast, while Backcasting illustrates the way to achieve the future vision.

Figure 7. Subsystems elements



Applicability in the transport sector

At this stage of the research it is useful to consider an example of why this framework is needed.

A recent report from the Bureau on Transport and Regional Economics on greenhouse policy options (BTRE, 2002), discussed the way various options will help reduce emissions. Options such as ridesharing, high occupancy vehicle (HOV) lanes, park an ride and urban density, within many others mentioned in the report, illustrate how complex problems such as greenhouse gas emissions are still manage in a reductionist way. Even though the report mentions under *Integrated Strategies* that “the whole is greater than the sum of its parts”, the report emphasis is on the impact of each policy on greenhouse emissions, lacking a systems solution where all the policies can be considered as a “whole”. Therefore a framework that can illustrate an integrated solution or “Systemic Solution” will be most useful.

The transport sector in Australia accounts for around 14 percent of Australia’s greenhouse gas emissions (GGE). An example of a future vision for the framework in question could be a zero percent GGE. If Backcasting is developed, a wider variety of policies would arise from this vision, which in turn increases the options/scenarios that SEA would consider, giving a more inclusive and comprehensive solution.

Conclusions

This paper has outlined a conceptual framework for analysing sustainable development issues by integrating a tool, SEA, and an approach, Backcasting. This framework is couched within a systemic approach that offers the opportunity to design any policy, plan or program aiming for sustainability from start in such a way that past, present and future states of the system are considered as part of the same situation (and hence, the process analysed as a whole). This is the reason why it is also valuable for giving a sense of direction to the planning procedure.

The framework can also be helpful for organizing information relevant to the problem at in question and for noticing which information is missing in order to give a comprehensive and complete overview of the problem. Thus integration and coordination are enhanced contributing to efficient planning.

The next stage of this work is to select a suitable case study application. The main characteristics to be considered in the selection of a case study include: the long term perspective of the problem; the strategic level (Policy, Plan or Program) context; the aim for a solution immersed in sustainability; significant feedback from stakeholders; and the relationship between transport and the environment. This work will be undertaken as a part of a doctoral research degree being carried out in the Transport Research Centre at RMIT University.

Acknowledgements

The author wishes to thank Jenny Morris, Francis McGinley, Ray Brindle and Mike Berry for some helpful comments.

References

Arnold, M. and Osorio, F. (1998) Introduction to General System Theory Basic Concepts *Cinta de Moebio. Electronic Journal of Social Sciences Epistemology,* **3**

Barrera, J. (2000) *Technology for lecturing staff,* Quipu, Buenos Aires

BTRE (2002) *Greenhouse Policy Options for Transport* Report 105 BTRE, Canberra

Dalal-Clayton, B. and Sadler, B. (1998) Strategic Environmental Assessment Review: A Rapidly Evolving Approach *Directory of Impact Assessment Guidelines* (Eds, Donnelly, A., Dalal-Clayton, B. and Hughes, R.) International Institute for Environment and Development, London

Dreborg, K.-H. (1996) Essence of Backcasting *Futures* **28,** 813-828

Guhnemann, A. (1999) SEA and Sustainable Development in the Baltic Sea Region *OECD/ECMT Conference on Strategic Environmental Assessment for Transport:* Warsaw

Hast, E., Oldmark, J., Huss, M., Robert, K.-H. and Heinz, A. (2000) *How to turn incremental improvements into steps to sustainability. Using a Combined backcasting/forecasting methodology* The Natural Step Foundation, Stockholm

Holmberg, J. and Robert, K.-H. (2000) Backcasting from non-overlaping sustainability principles-a framework for strategic planning *International Journal for Sustainable Development and World Ecology,* **7**

Kuisma, J. (2000) Backcasting for Sustainable Strategies in the Energy Sector. A Case Study at FORTUM Power and Heat *Environmental Management and Policy* Lund University, Lund

Newton, P. (1998) Environmental Indicators for Human Settlements *Measuring Progress: Is Life Getting Better?* (Ed, Eckersley, R.) CSIRO Publishing, Melbourne

OECD (1993) *OECD Core Set of Indicators for Environmental Performance Reviews* A Synthesis Report by the Group on the State of the Environment OECD, Paris

Partidario, M. R. (2000) Elements of an SEA framework-improving the added-value of SEA *Environmental Impact Assessment Review* **20,** 647-663

Robert, K.-H. (2000) Tools and concepts for sustainable development, how do they relate to a general framework for sustainable development, and to each other?*Journal of Cleaner Production* **8,** 243-254

Robert, K.-H., Schmidt-Bleek, B., Aloisi de Larderel, J., Basile, G., Jansen, J. L., Kuehr, R., Price Thomas, P., Suzuki, M., Hawken, M. and Wackernagel, M. (2002) Strategic sustainable development-selection, design and synergies of applied tools*Journal of Cleaner Production* **10,** 197-214

Rotmans, J. (1999) *Integrated Assessment. A bird's-eye view* International Centre for Integrative Studies (ICIS)-Maastricht University, Maastricht

Sheate, W. R. (1992) Strategic Environmental Assessment in the Transport Sector *Project Appraisal* **7,** 170-174

Therivel, R., Wilson, E., Thompson, S., Heaney, D. and Pritchard, D. (1995) *Strategic Environmental Assessment,* Earthscan Publications Ltd, London

TNS (2000) *The TNS Framework* The Natural Step Environmental Institute Australia

WCED (1987) *Our Common Future,* Oxford University Press, Oxford