Facilitating the use of research in policy development and implementation

Final Report July 2014

Bradley Jorgensen, Eve Merton, Liam Smith, Phil Wallis

ISBN: 978 0 7340 5013 7

Contents

Executive summary 4

Background 4

Approach 4

Findings 5

Implications for policymakers 5

An authorising environment 6

Addressing power inequalities 6

Raising awareness and building support 6

Tailoring research results to user needs 6

Introduction 7

Contemplating how knowledge is used 9

A process model of knowledge use 10

Empirical evidence of the conditions that promote knowledge use 12

Research-to-policy methodology 14

Case Study 1: the Decision-Taking Project 16

Description and methodology 16

Participant observation results 16

Questionnaire results 17

Discussion 18

Case Study 2: the Water Infrastructure Project 20

Description and methodology 20

Developing and disseminating the policy brief 20

Participant observation results 21

Discussion 22

Case Study 3: the Spatial Planning Project 24

Description and methodology 24

The stakeholder workshop 24

Policy briefs 25

Results 25

Research dissemination workshop and questionnaire results 25

Workshop assessment 27

Participant observation results 28

Discussion 29
General discussion 33
What kinds of strategies for which projects? 33
An authorising environment 34
Addressing power inequalities 35
Raising awareness and building support 35
Tailoring research results to user needs 35
References 36
Appendix 1: Spatial planning workshop questionnaire 38
Appendix 2: Decision-taking workshop agenda 39
Appendix 3: Water infrastructure project policy brief 40
Appendix 4: Spatial planning workshop agenda 48
Appendix 5: Spatial planning policy briefs 49

Executive summary

Background

Many discussions about the use of research knowledge in policy recognise the inherent difficulties in relating the spheres of academia and public policy. Much of this literature introduces models that emphasise the co-production of knowledge through collaboration between policy professionals and academics as a potential solution to improve the translation of research findings into policy. Key to these new models is the development of approaches, processes and institutions that enable stakeholder interaction in the research process: from how problems are conceived, the methodologies employed, through to how the knowledge is used (Woolgar, 2000).

Knowledge use can be thought of in three general ways:

1. "Instrumental use" of knowledge whereby facts are produced and applied directly to solve policy problems.
2. "Conceptual use" of knowledge to change established ways of thinking about current issues and to identify new issues that were not recognisable from established perspectives.
3. "Strategic uses" of knowledge for tactical or political purposes (e.g., to support or challenge existing positions).

These uses of knowledge can be achieved through three kinds of approaches: dissemination, interaction and facilitation. "Dissemination" involves tailoring the content and format of research products to the needs of the potential users. "Interaction" refers to the development of two-way communication processes and trust between stakeholders. "Facilitation" is about increasing the opportunity and capacity of stakeholders to share and use knowledge. Any single knowledge use strategy (e.g., a stakeholder workshop) can comprise a combination of all three approaches.

Approach

Three research projects funded by VCCCAR were selected to study research-to-policy interventions that might better facilitate the use of their respective results. These case studies were selected because they had progressed to a point that aligned with the time table of our "Research-to-Policy" project and they were amenable to the type of interventions that might facilitate knowledge use. The interventions and data generation methods employed in the case studies are summarised in the following table which lists four types of interventions and three types of data collection techniques.

Table 1. The projects, interventions and data

Project title	Research-to-policy interventions	Data generation methods
The Decision-Taking Project	Workshop	Participant Observations and Questionnaire[a]
The Water Infrastructure Project	Face-to-Face Meetings, Policy Brief and Seminar	Participant Observations
The Spatial Planning Project	Workshop and Policy Brief	Focus Groups, Questionnaire and Participant Observations

Findings

The range of knowledge use strategies drawn from the three case studies are summarised in Table 2 under the headings of facilitation, interaction and dissemination although some strategies straddle more than one domain.

Table 2. Knowledge use strategies arising from the case studies

Facilitation strategies
• Enable the range of potential stakeholder interests to be represented in the framing of research and in the production of research outputs (e.g., through public involvement mechanisms and the application of fair participation processes). • Provide opportunities for potential users of research results to meet and discuss how the research might be applied (e.g., presentations to relevant committees, community workshops). • Use a boundary organisation to create the space in which researchers, policy-makers, and other relevant interests interact. • Recognise that employee roles can restrict individual autonomy to use research results.
Interaction strategies
• Support individuals engaged in boundary work with technical, financial and leadership support. • Manage personnel changes as they limit effective communication and relationship-building between organisations and groups. • Improve the system of commissioning and managing research by introducing policy-makers to the potential benefits of flexible research models that foster realistic expectations. • Recognise that successful communication between key individuals involved in collaboration and co-production requires face-to-face meetings and personal qualities such as enthusiasm, commitment, trustworthiness, and good interpersonal skills.
Dissemination strategies
• Co-produce research products that are tailored to the specific uses, users, and policy context. • Understand the manner in which research is deemed to be 'useful' by users and determine how this criteria can be met or improved upon. • Build support for the research by publishing/presenting the results in professional fora and publications. • Build support for the research results by recruiting influential champions to speak for it.

Implications for policymakers

The case studies demonstrate some common strategies, such as disseminating research results in formats that are likely to be accessible and applicable to the intended users. However, some types of strategies were more specific to particular case studies. For example, knowledge use strategies identified in the decision-taking project workshop in Gippsland (which was about validating research results) were concerned with developing relationships and more inclusive decision-making procedures, rather than dissemination strategies. In the spatial planning project, in contrast, strategies tended to be about dissemination (although some strategies were also about interaction and facilitation).

Four basic conditions for improving the potential for research knowledge use were identified in the research:

- an authorising environment
- addressing power inequalities
- raising awareness and building support
- tailoring results to the needs of users.

An authorising environment

If a positive authorising environment can be provided by the government research partners, either formally or informally, they will be better able to champion research development and outputs. The facilitation of regular activities with appropriate resourcing in terms of people and time seems necessary for the research results to be developed, shaped and presented in an accessible way.

Future research could assess different knowledge-use strategies within research designs, to enable comparisons between approaches. However, we have demonstrated that, at a minimum, the co-production of policy briefs can increase the likelihood of research results being accessed and used in the policy sphere.

Addressing power inequalities

Power dynamics operating within social, historical and political contexts can have an impact on the way in which research results are generated and intended to be applied. Even power dynamics within organisations may limit the ability to influence executive decision-making and practices.

An understanding of the broader social context (e.g. community structures, organisational cultures and structures) in which research results are introduced is vital to ensure effective knowledge use in the formation and delivery of policy and programs.

Raising awareness and building support

Raising awareness and building support may be difficult to achieve when the targets of these endeavours are not also involved in earlier stages of the research cycle. Therefore, activities seeking to recruit policy champions, for example, are more likely to be successful if target individuals and organisations are included in discussions early in the research framing and planning phases.

Tailoring research results to user needs

Greater care and consideration of the packaging of research results is likely to increase appeal and use in policy. The packaging (or communication and dissemination) of research results, like building support, is an activity that is better planned for earlier in the research process. In this way, outputs such as policy briefs and other alternatives can be identified as project deliverables rather than as supplementary ‘re-packaging’ activities.

Introduction

Over the years, the issue of providing an evidence base for policy decision-making has raised questions in both the popular press (Milman, 2013; Tyler, 2013) and the academic community (Kirchhoff et al., 2013; Sutherland et al., 2012, 2013) about the production of scientific knowledge and the role of the modern academic. Many discussions about the use of scientific knowledge in policy recognise the inherent difficulties in relating the spheres of academia and public policy. Much of this literature has suggested an emphasis on the co-production of knowledge through collaboration between policy professionals and academics as a potential solution to improve the translation of research findings into policy.

Approaches to promoting the use and acceptance of research can be placed within broader discussions about the democratization of research in society (Funtowicz and Ravetz, 1993). Tebes, Thai and Matlin (2014) for instance argue that science in the 21st Century is developing a new narrative in which the research process is "fundamentally, a relational process in which knowledge is produced (or co-produced) through transactions among researchers or among researchers and public stakeholders" (p.475). This new narrative is emerging from interactions among researchers from different disciplines working in teams and actively engaging with policy-makers and the public to address important issues of the day.

Others too have noted that the nature of research has been changing (Funtowicz and Ravetz, 2003; Gibbons, 2000; Kirchhoff, Lemos and Dessai, 2013). Specifically, science has evolved from a disciplinary-pure enterprise with a focus on basic research (referred to as "Mode 1" research) to what Gibbons has called "Mode 2" models of research which featured the production of trans-disciplinary knowledge subject to stakeholder review (see Figure 1). Going beyond Mode 2 research are "post-normal" research frameworks and practices. Emerging from the interdisciplinary realm of ecological economics, post-normal science "comprises those inquiries that occur at the interfaces of science and policy where uncertainties and value-loadings are critical" (Funtowicz and Ravetz, 2003, p.4). According to Kirchhoff et al. (2013), post-normal approaches to knowledge production "better characterize the evolving relationship between science, scientists, the public, and policy" (p.396). The development of these new ways of thinking about knowledge production are a product of the complexity of contemporary issues such as climate change and sustainability which require different types of knowledge and ways of understanding the world, and a more flexible, interactive, iterative and 'non-linear' process of producing knowledge.

While a review of the range of perspectives regarding the use of research in policy and practice is beyond the scope of this paper, it is important to appreciate that there is a significant literature seeking to facilitate the use of knowledge by proposing new ways for it to be produced and communicated. Key to these new models is the development of institutions that enable stakeholder interaction in the research process: from how problems are conceived, the methodologies employed, through to how the knowledge is used (Woolgar, 2000). Increasing interest has grown in the establishment of institutions that can broker knowledge, resources and services between the research, policy and practice spheres. These institutions or "boundary organizations" (Guston, 2001) operate as forums for the interaction and coordination of stakeholder

decision-making and activities (Vogel et al., 2007) and to "stabilize the knowledge production function by providing a protective layer against the undue influence of extraneous factors such as politics" (Kirchhoff et al., 2013, p.398). This latter function allows for the operation of social learning processes by which stakeholders involved in the co-production of knowledge can come to know each other's values and interests (Reed et al., 2010; Ison et al., 2013).

For Kirchhoff et al. (2013) social learning and co-production are part of the progression from traditional ways of producing scientific knowledge to post-normal science where co-production exists and social learning is an important part of stakeholder relationships. As shown in Figure 1, co-production and social learning represent recent points in the "evolution in the complexity in both knowledge production on the one hand … and user participation on the other" (p.397). In social learning, knowledge stakeholders learn about each other and from each other as their interaction shapes a shared social context in which mutually understood problems are deliberated upon to achieve agreed solutions. With its emphasis on stakeholder involvement in all aspects of the research process, post-normal approaches are not located on either side of the so-called research-policy gap but, instead, focus on the things that researchers and policy-makers can do together.

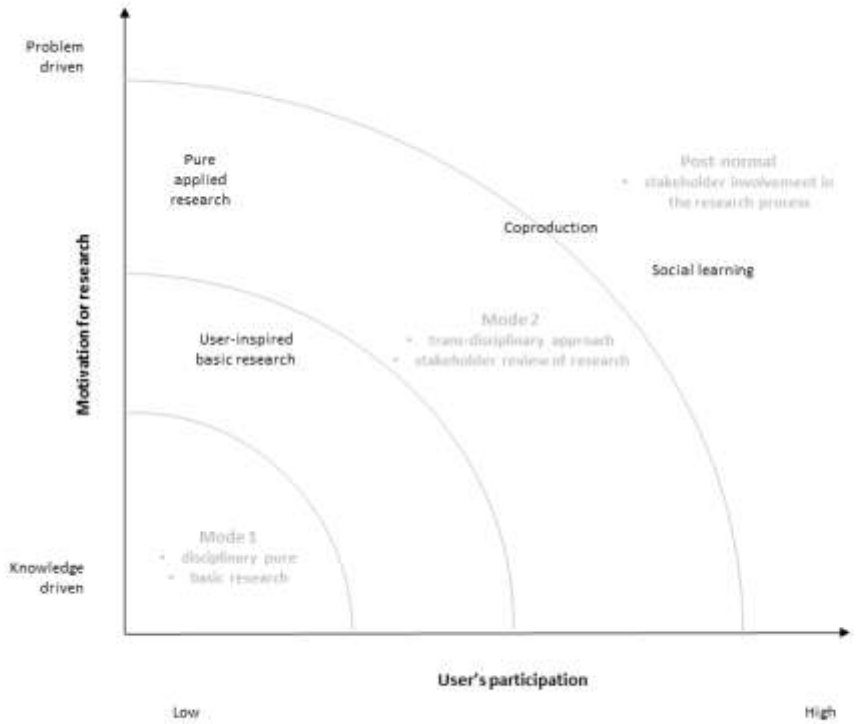

Figure 1. Evolution in the complexity of knowledge production and user participation. On the vertical axis, the complexity of knowledge production increases from low (where production is predominately focused on increasing our fundamental knowledge) to high (where production aims to help solve societal problems). On

the horizontal axis, the complexity of user participation changes from low to high as users become increasingly active agents in the knowledge creation process (Kirchhoff et al., 2013, p.397).

Contemplating how knowledge is used

Arguably, one development in the study of the research-policy nexus that has done most to increase the use of research has been to broaden the meaning of the term "use". In her seminal work, Weiss (1979) described seven different meanings with the direct application of research to a real world problem being characteristic of traditional ways of thinking about use. Weiss regarded these types of uses as rare when thinking about the application of social science knowledge. More common in her view was the "enlightenment model" of use in which it is the concepts and theoretical perspectives that social science develops that become taken-for-grated ways of thinking in the policy-making process.

With this broadening in what passes as "use" it can be appreciated that the extent to which research influences policy depends in part on the criteria used to operationalise "use". Rich (1997) informed his ideas about 'knowledge use' and 'policy influence' by noting such concepts can be understood as both outcomes and processes. With this distinction in mind, he further drew lines between four different types of use:

(1) "Use" may simply mean that information has been received and read.
(2) "Utility"… represents some user's judgment that information could be relevant or of value for some purpose which has not been identified as of yet.
(3) "Influence"… means that information has contributed to a decision, an action, or to a way of thinking about a problem.
(4) "Impact" is more action-oriented … information has been received, understood, and it has led to some concrete action, even if that action is to reject the information. (Rich, 1997, p.15)

Within this framework, knowledge use extends from passive forms (e.g., reading information) to influencing action.

A similar distinction in the meaning of knowledge use owing to Weiss (1979) and Rich (1997) is between "instrumental use" and "conceptual use":

> …different authors define the concept of knowledge utilization in different ways: for some, utilization means specific actions taken on the basis of knowledge (instrumental use). For others there is a more diffuse and indirect form of utilization (conceptual use). (Ridaelli, 1995, p.161)

Waylen and Young (2014) used this distinction when they examined how a national assessment initiative was expected to influence knowledge use and the strategies used to meet these expectations. The authors reported that many of their interviewees sought to achieve the "instrumental use" of knowledge whereby facts are produced and applied directly to solve policy problems. However, other types of use were found to be more prevalent. Specifically, "conceptual uses" (i.e., "the influence of knowledge, often incrementally or intangibly, to change mindsets about existing issues, or to identify new issues") and "strategic uses" (i.e., "the tactical or political use of knowledge … to support or challenge existing positions") (Waylen and Young, 2014, p.231).

A process model of knowledge use

Following earlier work by Nutley et al. (2007), Waylen and Young (2014) developed a simple model that shows the indirect and direct relationships between intervention strategies and the use of knowledge (see Figure 2). While the relationships involving instrumental and conceptual uses in the model are clearly shown, the links involving strategic use are ambiguous because this type of use frequently goes unacknowledged in that it provides power to justify actions beyond the original intent of the research and can be regarded as "misuse".

The figure represents the three bases of communication (i.e., dissemination, interaction and facilitation) as independent interventions, but any single strategy could comprise a combination of all three interventions. For example, a workshop focused on the dissemination of knowledge produced without co-production can contribute to the re-shaping of that knowledge through activities grounded in two-way communication processes such as deliberative decision-making groups. Facilitation may also have been important in providing opportunities for decision-makers to come together in ways that lead to co-production.

The authors suggested that knowledge communication and subsequently knowledge use can be facilitated through improving interaction (i.e., introducing two-way communication processes), facilitation (i.e., improving the capacity to share and use knowledge) and dissemination (i.e., tailoring knowledge content to user needs). Furthermore, the influence of the three types of intervention on knowledge communication interact in ways that ultimately result in the co-production criteria established by Cash et al. (2003), namely salience (or relevance), credibility and legitimacy (SCL criteria). For example, when organisations fund, reward and normatively sanction knowledge-sharing and relationship-building, interactions between parties can create trust over time resulting in co-produced knowledge and tools that are easily disseminated and used in practice. Also explicit in the model is the idea that facilitation and interaction can influence conceptual use which is regarded as the most common use of knowledge by a number of authors (e.g., Owens, 2005; Waylen and Young, 2014; Weiss, 1979). This aspect of the model is supported by Nutley et al. (2007) who pointed out that the process of interaction between knowledge producers and users may result in fostering trust, long-term learning and new ways of thinking about current problems.

According to Waylen and Young (2014) dissemination interventions tend to focus on tailoring the presentation of knowledge produced in a traditional manager (e.g., without co-production) in ways that increase its perceived relevance to users. In this sense, dissemination can be understood as a marketing approach in which the knowledge producers seeks to understand what knowledge is required and how it is used, but the user is not directly involved in the production of that knowledge. This type of intervention can lead directly to instrumental use to the extent that the knowledge comes to be recognised by users as relevant, credible and legitimate.

Of the three pathways to knowledge use (i.e., dissemination, interaction and facilitation), the authors argue that dissemination strategies aimed at re-packaging information to promote its perceived legitimacy, credibility and relevance is the most common because instrumental use (i.e., the transfer of facts into policy) remains foremost in thinking about knowledge use. However, conceptual use was found to be the more common form of use in the study by Waylen and Young

(2014). The main pathway to conceptual use relies on two-way communication processes and is heavily dependent upon the effectiveness of interaction among those involved in knowledge coproduction. That is, unlike dissemination which relies on re-shaping knowledge presentation rather than knowledge content, conceptual use is influenced by how communication is managed in the context of co-production. Finally, the model shows that communication processes involved in dissemination and relationship-building have a basis in facilitation which is required in order for activities such as co-production to occur.

The model offered by Waylen and Young (2014) is based on their study of the National Ecosystem Assessment in the UK. For this reason, the interventions that might be implemented and the communication processes that could be facilitated are typically those that might be expected activities for a boundary organisation rather than as one-off interventions aimed at bridging the so-called research-policy gap.

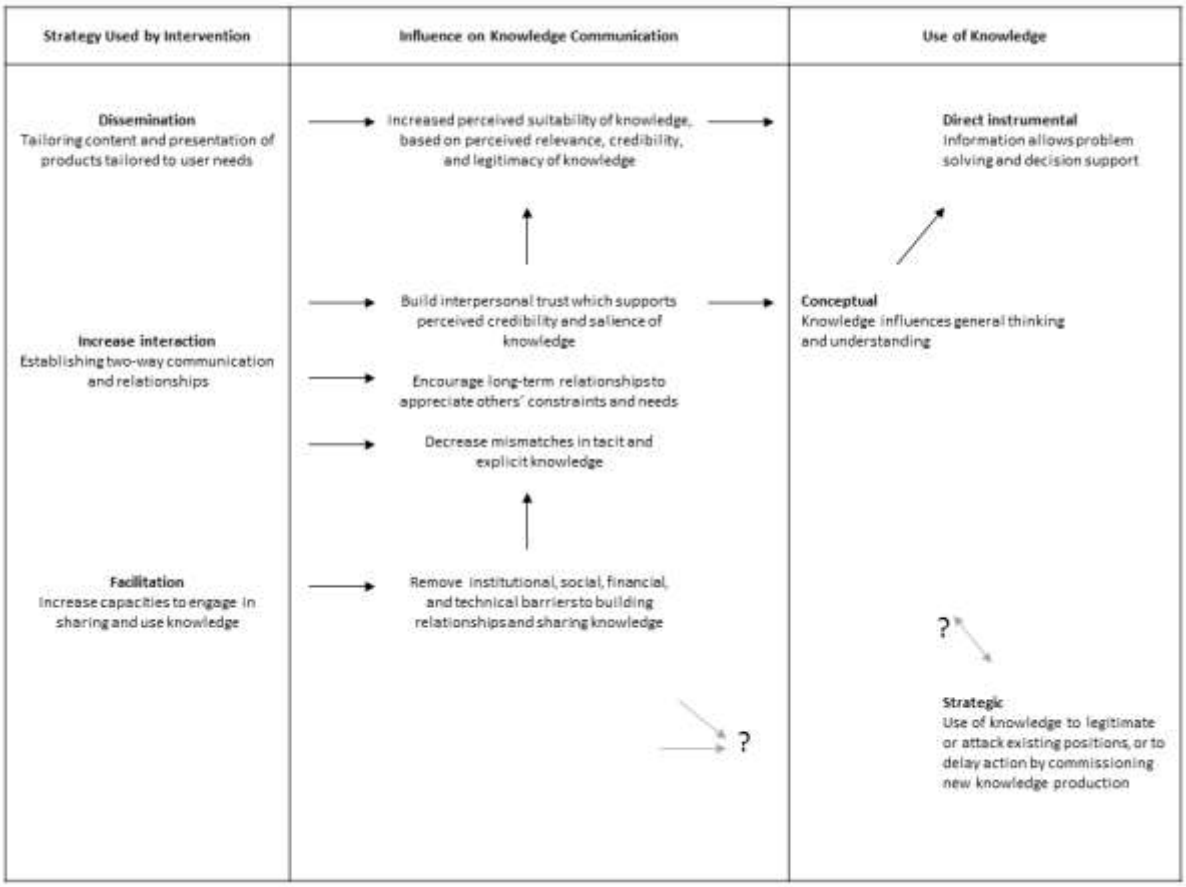

Figure 2. A conceptual model highlighting how interventions may adopt different strategies to increase knowledge use, and how these may be expected to influence communication and uses of knowledge (Waylen and Young, 2014, p.232).

A number of authors have argued that our understanding of boundary organisations and "boundary work" is insufficient (Jordan and Russel, 2014; Kirchhoff et al., 2013; Owens, 2005; Vogel et al., 2007;

Waylen and Young, 2014). Vogel et al. for example stated that "more social science research is needed to measure the effectiveness and outcomes of direct science-practitioner and boundary organisation-mediated communication" (p.355). Kirchhoff et al. called for ethnographic studies about how science informs decision-making and for experimental approaches to discern how planned interventions might influence the adoption of scientific knowledge by decision-makers. Jordan and Russel (2014) concluded from an overview of studies that more research is needed that employs "mixed methods, including documentary analysis, focus groups, citation studies, interviews, ethnography, and even quasi‐experimental approaches" (p.202). For Owen (2005, p.290) "Such work should enrich our conceptions of how, why, when and in combination with what other factors, research might actually come to have influence."

In this spirit, the following sections of this report summarise some assessments of strategies that have been employed to facilitate the dissemination and use of research in policy environments, and describes the outcomes of a workshop employed to identify how policy professionals believe research results might be disseminated in ways that would promote its use.

Empirical evidence of the conditions that promote knowledge use

Nutley et al. (2007, cited by Jung et al., 2010, p.214) refer to the following range of practices to increase research impact, many of which can be organised within the three bases of communication in the model by Waylen and Young (2014):

- research translation and the tailoring of findings to specific policy and practice contexts (dissemination);
- enthusiasm of key individuals and personal contact between research producers and research users (interaction);
- targeting of specific barriers to and enablers of change (facilitation);
- credibility based on strong evidence from trusted sources (dissemination and interaction);
- leadership within both research production and research impact settings (facilitation);
- ongoing financial, technical and emotional support (facilitation);
- integration of new activities within existing systems (facilitation).

Similar conditions have been reported in other studies. For example, in his review paper, Adamo (2003) reported that policy influence was achieved when stakeholders were able to address policy issues as they arose, and acted to ensure that the research outputs were timely and focused on the needs of policymakers. Also important was the reputation of individual researchers and research institutions among policy-makers and the relevance and quality of the research outputs. Another factor concerned the openness of government and other institutions to policy reform and a commitment to use research results in policy development. The conditions that inhibited policy influence reported by Adamo stood contrary to the facilitating conditions. That is, low relevance, resistance from interest groups, an unsupportive policy environment, and a cumbersome and opaque policy-making processes.

Some studies have found dissemination and interaction interventions to be effective means of promoting knowledge use. For example, Landy et al. (2001) refer to "the dissemination model" of knowledge use:

> The *dissemination model* was developed in response to the fact that while examples of unplanned knowledge transfer existed, knowledge transfer was not automatic. This model suggests that a step should be added to research activities by developing dissemination mechanisms to identify useful knowledge and transfer it to potential users. (p.335)

Landy et al (2001) identified a major weakness in the dissemination model from the standpoint of post-normal science. That is, policy-makers are not involved in the production of the research outputs or in the decision-making process determining what knowledge is of potential use. This lack of engagement and co-production hinders the realisation of using the disseminated information in policy.

A second model discussed in Landy et al. (2001) is "the interaction model". This model recognises that knowledge use arises from interactions among researchers and policy-makers that cannot reasonably described as linear in organisation. The focus of this model, unlike the dissemination model, is upon "the relationship between researchers and users at different stages of knowledge production, dissemination and utilization" (p.335). Therefore, for Landy et al., the interaction model encompasses and extends the dissemination model.

Landy et al (2001) operationalised variables relevant to each model and tested their ability to explain a self-reported index of knowledge utilization using survey data from 1229 Canadian academics from a range of social science disciplines. Across disciplines, the model explained 60% of the variance in knowledge utilization with the dissemination and interaction variables having significant effects. There were some discipline-specific effects where dissemination and interaction were concerned. This notwithstanding, the authors found that dissemination and interaction were important determinants of knowledge utilization.

In her review of 150 articles concerning research utilisation, Hemsley-Brown (2004) was able to synthesise the main findings regarding a range of strategies including dissemination activities and interactions (referred to as "collaboration, partnership and links" by Hemsley-Brown). The review suggested that there was little research regarding the effectiveness of dissemination strategies. However, in the material that was available from the review, Hemsley-Brown emphasised tailoring research outputs to the particular needs of different users, targeting specific groups rather than a mass audience, and to disseminate research through networking activities. While these factors may be expected to increase knowledge use, the review was not a meta-analysis such that quantitative evidence of their effects was not provided.

For interaction strategies, Hemsley-Brown (2004) found evidence to support the increasing involvement of users in the research process, developing stronger communication networks and links between researchers and users, and providing opportunities for researchers to work with users. Evidence from the review indicated that these types of activities increased mutual trust between

collaborators. From the review, however, it is not clear to what extent these types of activities facilitate the use of research in policy.

In their study of the National Ecosystem Assessment (NEA) in the UK, Waylen and Young (2014) described a cross-review process utilized by the NEA. This activity gave policy stakeholders the opportunity to review the contributions of academics, provide feedback to the academics concerned, and receive responses to this feedback. The cross-review process represented a highly structured form of two-way communication and can be seen as a type of interaction intervention. While a time-intensive strategy by the authors' account, the interaction between parties enabled a basic form of co-production that could lead to the instrumental use of the information produced by the NEA:

> For users, particularly those groups not formerly connected, this process could have increased the salience of the report and process, so increasing the perceived relevance of the final report. Furthermore, it may also have assisted with perceived credibility—as reviewing was widely supported by interviewees as an essential tool for quality control—and also have increased legitimacy, because those organisations who were invited to comment could not so easily argue later that their views had not been taken on board. (Waylen and Young, 2014, p.238)

The research considered to this point suggests that interaction and dissemination can promote the conceptual and instrumental use of research knowledge. In the following section, a methodology is described that seeks to utilise stakeholder interaction and deliberation as a means of identifying research dissemination strategies.

Research-to-policy methodology

Three research projects funded by VCCCAR were selected to study research-to-policy interventions that might facilitate the policy use of their respective results. These projects were selected because they had progressed to a point that aligned with the time table of our "Research-to-Policy" project and they were amenable to the type of interventions that might facilitate knowledge use. Importantly, none of the research projects were designed with co-production in mind. Rather, the researchers and policy professionals involved in each project adopted fairly standard roles as research producers and research consumers respectively. These projects and the research-to-policy interventions that were introduced toward the end of their durations are presented as case studies in the following sections of the report. The interventions and data generation methods are summarised in the following table which lists four types of interventions and three types of data collection techniques.

Table 1. The projects, interventions and data

Project title	Research-to-policy interventions	Data generation methods
The Decision-Taking Project	Workshop	Participant Observations and Questionnaire[a]
The Water Infrastructure Project	Face-to-Face Meetings, Policy Brief and Seminar	Participant Observations

The Spatial Planning Project	Workshop and Policy Brief	Focus Groups, Questionnaire and Participant Observations

[a] The questionnaire is provided in Appendix 1.

By-and-large, the research-to-policy interventions adapted to the selected VCCCAR projects were those that concern the packaging of research results in ways that promote their dissemination among policy users, and meetings that facilitate interaction (e.g., communication and co-production) among researchers and policy professionals. For example, workshops were held with stakeholders in order to provide feedback about the utility of the research outcomes and how they might be presented in order to facilitate their dissemination throughout the stakeholder organisations and elsewhere. Policy briefs were also produced as a dissemination strategy in two of the projects.

It should be noted at this point that it is not possible to know what policy impacts these interventions achieved because the collection of the follow-up data required to make such assessments is beyond the scope of this project. Nonetheless, in the discussion of these case studies we describe qualitative data and participant observations that bear on how the use of VCCCAR-funded research might be positioned to facilitate its use among policy professionals.

Case Study 1: the Decision-Taking Project

Description and methodology

The project entitled "Decision-Taking in Times of Uncertainty" was conducted by a team of individuals from the University of Melbourne, the Department of Primary Industries, and Monash University. These researchers sought to achieve the following objectives as stated in their application for funding:

- "Identifying key issues and understanding decision-making in climate change adaptation through a case study of Gippsland (with a focus on agriculture, planning and energy production."
- "Collaborating with stakeholders and developing guidelines for good governance of climate challenges."

The project methodology employed a range of techniques including text analysis, participant observation and stakeholder interviews. The research delivered a community workshop in which participants could discuss the project results in the context of a community-driven regional planning perspective (see Appendix 2 for the workshop agenda) and to propose ways in which they could be used to enhance decision-making in the region.

There were 15 participants, including the research team; nine from the region and six from Melbourne. Regional participants, who had not necessarily been involved directly with the project, came from a range of sectors, including local government, state government, health services, youth services, NGOs and the general community. This workshop is the focus of this report for which participant observation data is the basis of our analysis together with participant feedback in the form of personal communications.

Participant observation results

The observations in this section were first documented in a workshop report by the decision-taking project (see Zinn and Fitzsimons, 2014). During the workshop, participants actively engaged in conversations about a future for the Latrobe Valley where decision-making processes are inclusive, adaptable and transparent, and also benefit the region. Throughout the discussions it was readily apparent that the coal-based power industry in the region is a dominant influence on regional planning and development, while other industries and potential futures for the region under uncertainty (e.g., climate change) didn't have as strong a voice. Put simply, some groups have more power to influence decision-making and policy outcomes than other groups.

The narrowly-focused mindset and motivation of current decision-makers was considered a major barrier to good regional decision-making and also to the adoption of the research findings. Participants felt there was an assumption that the perceived economic benefits of exploiting the coal reserve would be so great as to be an inevitable part of any future for the Latrobe Valley. A counter-narrative raised by the participants was that the coal industry only accounted for a small proportion of jobs regionally, and the coal focus was disproportionate in defining the region.

Although there was limited regional representation at the workshop, the participants were interested in the research findings and identified some tangible ways to take them up in their

activities. One use of the research was to take general outputs to regional decision-making processes and influence the way that governance structures are created around regional planning and decision-making in Gippsland. This would involve feeding back the research to the leadership group in charge of such processes.

Another response was that the research revealed opportunities for smaller groups to have an input to planning, either by inviting the leadership group to come to local level meetings for conversations, or by giving a presentation. By raising awareness of the research results while at the same time brokering and developing relationships, participants believed that community interests with little representation in decision-making might be able to use the research to gain a stronger voice.

A specific and immediate use of the research was to use the findings to guide the creation of two local area youth-oriented decision-making groups. Using the principles of local decision-making, rather than structures imposed from the outside, was seen as desirable. Although coal mining is historically and economically a prominent activity in the region, there was a view that young people needed an opportunity to have an opportunity to plan their own futures in the region.

Much of the workshop was spent discussing what good regional decision-making means in the face of uncertainty. These discussions heavily referenced or reflected the research findings, for example, that decision-making should be:

- inclusive so as to enable a diversity of views,
- demonstrate vision and go beyond routine processes,
- have clarity around governance, and
- engage with political uncertainty and power in an open and inclusive way.

Questionnaire results

Three participants agreed to be contacted for encouragement to return a workshop evaluation form; although only one did so (other participants did not agree to follow up). This participant felt that the research results were consistent with his/her understanding of the decision-making processes and structures operating in regional Gippsland. For this participant, planning decisions are strongly influenced by a core group of senior managers and executives partly through their representation on key committees responsible for strategic planning in the region. This core group of influential decision-makers tend to adopt unreflective positions regarding planning, and demonstrate a level of 'group think' by emphasising past planning objectives and economic drivers rather than establishing communication channels and deliberative forums that engage a range of views about the region. The participant did not think that enough attention was given in the workshop to this problem of introducing "inclusive and considered decision-making processes" in light of the entrenched positions of a small, powerful group. Therefore, this participant, effective dissemination of the results requires an appreciation of how power is distributed and used within the region.

Perhaps a less complicated strategy for dissemination was the suggestion that fact sheets (as components of policy guidelines) be forwarded to the participant so that they can be easily accessed by senior executives in his/her organisation. The timing of these fact sheets was important for the

participant because he/she felt that the momentum would be lost if the material wasn't provided soon after the workshop.

It was also recommended that the researchers present their results at key forums to build support among a broader range of interests than just those attending the workshop. According to the participant, the following committees and groups should be approached:

> …the Gippsland Regional Plan Review committee, the Gippsland Climate Change Network, the steering committee for the Victorian Adaptation & Sustainability Partnership (VASP) regional project, the Regional Managers Forum (if it is still functional), Gippsland Local Government Network, Gippsland Community Leadership Program, Committee for Gippsland. Keep it short and sharp.

Related to the above was the participant's contention that there were individuals absent from the workshop who would benefit from learning about the research results:

> This was useful to me, but is unlikely to be useful to those who did not attend. I don't think the workshop explored how this work can be utilised within organisations by those who were not present. It would have been good to discuss this further and come up with some suggestions.

In addition, the participant believed that the 'planning community' in Gippsland were effective at working together, but not so good at communications within organisations and between different levels of different organisations. Part of this problem has a basis in recent personnel changes within organisations and community groups:

> When key personnel change (e.g., Executive Officers for these groups) or groups change, or organisations are downsized, the lines of communication between these areas of activity can break down.

Discussion

In the workshop participants gave some attention to the topic and their discussions about planning practices and processes in their region highlighted the importance of the local context for research-to-policy initiatives. One insight to emerge from the observational and questionnaire data was the appreciation that knowledge production and its communication occur in a social context in which power is unevenly distributed (Richardson, 1996). The model by Waylen and Young (2014) does not detail how vested interests might limit the policy use of knowledge although it recognises that knowledge can be used in strategic ways. Moreover, the model's appreciation of the importance of facilitating the sharing and use of knowledge by removing institutional, social and other types of barriers presumably includes barriers grounded in power inequities.

That the model does not explicitly deal with individual and institutional power dynamics is perhaps unsurprising given that ideal post-normal approaches to knowledge production are inclusive of stakeholder interests and embrace social learning processes and procedural justice principles to establish research frames and key policy issues. In this respect, conflict over particular definitions of particular policy issues would ideally be dealt with early in the research process. Alternatively, unresolvable differences in stakeholder views may be enough to end the collaboration. Either way, the model does not address the explicitly political nature of policy development and might be regarded as somewhat simplistic in how applied policy research is initiated and undertaken. To the

extent that vested interests are opposed to particular framings and/or research results, opportunities to make use of the knowledge are likely to be limited. In this respect, broader public involvement processes recognised in post-normal approaches should be characteristic of the research process rather than simply the inclusion of the interests of policy professionals and university researchers (Taylor, 2011).

Workshop participants nominated some strategies to use the research results in decision-making. At the most basic level, all of these suggestions involve relationship brokering and development between researchers, the community and decision-makers. First, participants believed that presenting the research directly to regional leaders with the goal of influencing how planning and decision-making operate in Gippsland. Second, bringing decision-making leaders and smaller local interests together was thought to be a way of creating better planning outcomes. A third way by which the research might be used was to apply the results to create decision-making forums for local youth that would presumably be represented in planning processes.

These three strategies for using the research seem to be grounded in interaction between decision-makers, researchers and the community, and by facilitating the expression of youth interests so that their voice might be heard in decision-making. This is not to say that dissemination of the research results might not be involved through these activities (as represented in Waylen and Young, 2014) rather to recognise that participants seem to focus first on establishing the conditions to enable two-way communication and relationships.

Case Study 2: the Water Infrastructure Project

Description and methodology

The 'Water Infrastructure Project' was conducted by a team of researchers from La Trobe University and the University of Melbourne. It aimed originally to deliberately engage with key personnel in water businesses (i.e. North East Water, Coliban Water, Yarra Valley Water and City West Water) and the Essential Services Commission, and to include individuals representing the Victorian Department of Primary Industries. Based on the project research proposal to VCCCAR, the initial research objective was defined in the following way:

> "To enhance regulatory and policy assessment of water infrastructure, by systematically accounting for the uncertainties embodied in climate change and hydrological modelling."

The project methodology was to apply alternative models of economic analysis under uncertainty to a range of water infrastructure investment projects across Victoria, to assess appropriate policy options for water utilities, regulators and other government agencies. The aim was to improve the provision of water supply infrastructure by accounting explicitly for the prospects for climate change.

The project was initially concerned with the idea of using real options approaches to assess water infrastructure investments. The real options approach was intended to be an adjunct to the normal cost–benefit analysis that is carried out before investment decisions are taken. Following initial research and literature review, it appeared that real options may not be the only effective approach to answer the research questions. Some parts of the project continued to use this method, but the project was also expanded to allow the use of other models for understanding economic investments under uncertainty. This represented an alignment of the academic research and the policy environment.

One project outcome was the application of real options theory, incorporating quasi option values into standard valuation approaches. This type of value is associated with deferring a large and irreversible investment (such as a desalination plant) in order to benefit from new information available in the future. The project developed the idea that, given the presence of significant uncertainty about the probability of likely future events, particularly for climate-related events under climate change (e.g. drought), there can be value in deferring investment decisions.

Developing and disseminating the policy brief

The key mode of knowledge dissemination proposed in the funding application was a strategy of engagement with targeted stakeholders throughout the course of the project and a planned workshop with participants from the water corporations and the Essential Services Commission.

As the project progressed, it was proposed by VCCCAR and DEPI that the project research lead work with individuals from DEPI and the Department of Treasury and Finance, to produce a policy brief 'Evaluating investment projects under risk and uncertainty' (Appendix 3). A series of face-to-face meetings and exchanges of various drafts ensued, which culminated in an 8-page policy brief, which

was presented in a seminar to high-level policy officials from the Department of Treasury and Finance.

The Department of Treasury and Finance subsequently asked for permission to forward the policy brief to be included in a Victorian Government submission for consideration by the Productivity Commission Inquiry into Infrastructure Costs (concluded in May 2014).[1]

Participant observation results

The development of the policy brief was driven by a Department of Environment and Primary Industries policy officer, who organised the meetings and the exchange of drafts. The representative from the Department of Treasury and Finance organised the final seminar and facilitated further dissemination within various government departments while on secondment to the Office of Living Victoria. A member of the Research-to-Policy research team was invited to participate by attending meetings and the final seminar, and was included in all email exchanges regarding the policy brief.

As previously discussed in our Milestone 3 report, the research lead on the project was an enthusiastic adopter and was pleased with the process and the outcome:

> I was really happy to get feedback from policy makers. In some cases they criticised things that I had done, in other cases they suggested things that I had done were a good idea … this was a very useful project from my viewpoint … I learnt a lot from the policymakers (Researcher, interview)

A policy professional involved in the face-to-face meetings to produce the policy brief saw the process as important in developing a useful research product partly because these interactions enabled clear discussions about what sort of information package was required from a policy perspective :

> I think that people came around more to a clear understanding of what we needed when I said to them 'well, in this particular case, because it's about … application of financial assessment procedures or practices' when you sort of comeback to say 'it's a moderately experienced policy officer or a junior economist who has got a basic, basic understanding' that then gave them more of an idea about what I was after (Policy officer, interview)

Several technical and academic outputs had been produced from the Water Infrastructure Project, but these were seen as inappropriate as research-into-policy outputs for policy professionals and decision-makers lacking economics expertise. In addition, up to the point where the policy brief began to be developed, there had been limited co-production opportunities. VCCCAR therefore requested an output that was:

> …presented in a way that can be used in decision-making frameworks used by the Department of Treasury and Finance and other departments to explain the real options work as an addition to standard cost–benefit analysis … [more specifically] for people in Treasury and Finance who do assessments, for people in other departments who put in bids to Treasury and Finance, and for consultants involved in cost–benefit analysis for Treasury and Finance and other departments' (VCCCAR Director, meeting notes).

[1] www.pc.gov.au/projects/inquiry/infrastructure

This request spans the instrumental, conceptual and strategic use range. Indeed, this was achieved despite the strong emphasis on instrumental use by keeping the audience in mind at all times during the development of the policy brief:

> What does a policy brief do? Can this policy brief provide this advice? Are the key points salient and will they appear on the front page? What will the brief look like — style, breakout boxes, table with key points? (Policy officer questions, meeting notes).

Even though this co-production activity was an unplanned 'add on' to the Water Infrastructure Project, the development of the policy brief and policy brief itself was very successful in the research-into-policy context. This was due to the activities of champions, and the provision of resources (time and person-hours) and the willingness of the policy officers to make it happen:

> … people in academia are often scared of applied work, so forcing people to engage is a good thing … [they need to ask] is Treasury interested, what do they think about my work … a branch may have strong links with academics, but they still can't apply the research work in the real world [of policymaking] (Policy officers, meeting notes).

There was also a clear window of opportunity with the Productivity Commission Inquiry, which was seized with the inclusion of the policy brief in the Victorian Government submission.

Discussion

The water infrastructure project progressed through a number of meetings between the research team and policy professionals who hoped to benefit from the research outputs. The individuals involved met regularly to exchange ideas, argue points of view, and coordinate their activities toward achieving a policy brief that was well-received by the government departments involved. The seminar presentation of the policy brief to high-level policy professionals was an additional means of disseminating the research results and ensured that key decision-makers and researchers had an opportunity to exchange views face-to-face.

One feature of the project was the provision of staff and time by the organisations involved. This facilitation strategy suggests that the authorising environment of the government research partners championed the research. It might also be concluded that the individual project members demonstrated commitment to progress the project outputs and then championing them in the appropriate policy forums.

The development of the policy brief enabled use of the research results. It is currently being employed to inform policy officers and to advocate a position in the Productivity Commission's inquiry. The former example shows conceptual use of the research results whereas the latter example might be interpreted as a strategic use to the extent that the brief was intended to either legitimate or critique an existing policy position. The production of the policy brief also highlights the interdependence of facilitation, interaction and dissemination strategies. Resources were gathered to enable individuals to interact in ways to re-package the research results in a more useable form.

The role of VCCCAR in requesting research outputs clearly targeted to particular users for specific uses may also have been important in facilitating the production of the policy brief and the up-take

of the research results. Therefore, keeping the audience in mind at all times might be one conclusion emerging from the participant observation data. If the user and the uses are understood, a range of uses (instrumental, conceptual and strategic) are possible. Certainly, the water infrastructure project seems to have facilitated the conditions for collaboration between project members and organisations, engendered effective relationships both between individual project members and organisations, developed clear ways of communicating, and presented research results in a manner that was informed by users' criteria of what constitutes 'useful' knowledge.

Finally, an aspect of the project that may have contributed to the use of the research results could be regarded as chance, timing or happenstance. It was fortuitous that the policy brief was produced within a timeframe that coincided with the submission of material to the Productivity Commission's inquiry. It is possible to plan for good timing by being 'ready to go' with material suitable for the up-take of research knowledge.

Case Study 3: the Spatial Planning Project

Description and methodology

The "Spatial Planning Project" (which was a component of the VCCCAR project 'Governance models for natural disaster risk management') had been undertaken by members of the Centre for Resources, Energy and Environmental Law (CREEL), the Construction Law Program, and the School of Engineering at Melbourne University. Other members of the spatial planning research team were members of the School of Law at La Trobe University and the Centre for Risk and Community Safety at RMIT. The research objectives stated in the funding proposal of the spatial planning project were:

- "To examine how law and governance influence adaptation to extreme event/natural disasters in Victoria; and,
- To make policy recommendations for effective measures to facilitate adaptation and assign risk between public/private sectors."

The stakeholder workshop

A stakeholder workshop was held to provide research and policy participants the opportunity to promote the use of spatial planning results by state government departments. One of the goals of the stakeholder workshop was to identify key research dissemination strategies within the context of the government departments represented (i.e. Departments of Planning and Community Development; Treasury and Finance; Transport Planning and Local Infrastructure; and Environment and Primary Industries) and given the nature of the spatial planning research information itself. Participants were invited to attend the workshop because they had been involved with the research from the outset as project partners.

Ideally, all stakeholders needed to have a good understanding of the spatial planning issues raised by the researchers and what they might mean for policy development. To familiarise the policy participants with the research results, a technical paper was distributed prior to the workshop. Furthermore, the first session of the workshop entailed 30-minutes of presentations by the researchers following which questions from among the policy participants were invited (see Appendix 4 for the workshop agenda). Importantly, these presentations were designed to provide clear interpretations of the research results and their basis in the relevant legal planning frameworks.

Following the session of presentations, participants were allocated to small groups in which to identify and discuss the research outcomes relevant to their particular portfolio. These discussion groups were facilitated by a spatial planning researcher who was able to respond to any questions raised by the participants. Therefore, the provision of the technical paper together with the research presentations were assumed to provide a strong basis upon which participants could provide informed feedback to the research group.

The last workshop session – and the focus of this report – involved the same small groups involved in the previous session. Participants were asked to identify a range of dissemination strategies that they and/or the researchers could undertake in order to raise the awareness and use of the research

results within their respective departments. These discussions were facilitated by members of the co-production team involved in planning and running the workshop. Therefore, this session of the workshop was designed to provide information to support research dissemination strategies, but used an interaction intervention to produce these insights.

At the end of the workshop, the participants were invited to evaluate the workshop process and to write down actions that might be undertaken to promote the use of the research in their organisations. By providing participants this second opportunity to identify dissemination strategies, we hoped to re-iterate the main strategies covered in the group discussions, but also to provide individuals with an avenue to make suggestions that may not have arisen previously.

Policy briefs

Following the workshop, one of the Research-to-Policy research team liaised with Victorian government officers to produce a series of summary policy briefs drawing upon the spatial planning project results. The objective of the series of briefs was to:

- identify aspects of the research findings of most interest and relevance to government departments and agencies
- present the information in a format that is highly useable by government officers, either for their own use or for use with a broader government audience.

The Researcher met with two representatives each from DEPI, DTPLI and the Office of the Fire Services Commissioner. She also met with a senior executive from DPC and received feedback from a meeting that a colleague held with a senior executive from DTPLI. Neither of the senior executives were directly involved in the spatial planning project, but were familiar with it and interested in the outcomes of the project and how they might take the research forward within government.

The purpose of the meetings was to identify topics of particular interest to the stakeholders and to get a sense of how they intended using the material in the policy briefs within their own departments and agencies. In addition, drafts of six policy briefs were emailed to all members of the Government Steering Committee for review and feedback. At the suggestion of one stakeholder, it was decided to create an overarching brief under which the series of policy briefs would 'nest' within. They have become appendices to the overarching brief (see Appendix 5).

Results

Research dissemination workshop and questionnaire results

Participants identified formal and informal strategies that could be undertaken and lead to wider recognition of the spatial planning research results in their departments. The range of strategies for facilitating the up-take of the spatial planning research results are discussed under three general headings in the following subsections. These headings refer to the need to (i) promote within organisations a realistic picture of knowledge and the research process, (ii) develop effective ways of raising awareness of, and support for, research outcomes, and (iii) presenting research in ways that are tailored to the needs and understandings of the users.

What is research?

One participant stated that research needed to be of a particular kind in order for it to be recognised and used. S/he described such research as "trimming the sails research" which is narrow in scope and problem-focused. Sometimes research requirements can be crisis-driven (e.g. Victorian Bushfires Royal Commission); in this mode, a consultant may be commissioned to provide an outcome within a short time frame. However, in the participant's view, the outcome may not be usable, but tight deadlines constrain the options available to policymakers.

On the basis of such views, understandings of how research is done and the organisational processes for commissioning and managing research represent barriers to using research for policy purposes. The description of the prevailing research process provided by the participant resembles the "problem-solving model" of research (Weiss, 1979) whereby a policy issue drives a linear research process with the goal of providing information to address a knowledge gap. Weiss remarked that this model harbours the unrealistic expectation that the research outputs can be directly applied to the policy context where the problem exists. The problem-solving model of research is the most common way of thinking about applied research despite not being a very successful way of conducting policy research in practice.

Apart from the manner in which research is understood, planned and commissioned, there also appear to be constraints upon the dissemination of research owing to informal ways of evaluating such information within policy organisations. According to one participant, research articles and reports get judged as to their (i) legitimacy (i.e., How accurate is the research?), (ii) relevance to a current policy issue facing the organisation (i.e., Is there a useful idea presented in the research?), and (iii) practicality (e.g., Does the idea protect the Department from risk? Is the idea feasible?).

These criteria resemble the SCL criteria established by Cash et al. (2003) noted earlier. It is not clear from the data at hand how these criteria are applied in practice or their relationship to different types of research information and outputs. Therefore, interpreting the participant's reflections on the process is difficult because it may be that research articles rarely enter policy decision-making because they either routinely fall short of the criteria or the criteria are unreachable.

Raising awareness and building support

Some participants felt that a supportive and pro-active (rather than re-active) authorising environment was required within their organisation, in order for research to have impact. Without this, they themselves would have few opportunities to influence strategic direction and activities.

Given such constraints, participants felt that the best strategy to give the spatial planning research greater prominence would be for the researchers to influence the Departmental agenda which is set at annual strategic planning meetings. Three participants pointed out that this could be achieved in their own organisation which was undertaking a process of staff consultation ahead of setting new directions for the organisation. Most participants believed that meetings with department Directors and other senior figures and organisations (e.g., the Municipal Association of Victoria, the Department of Environment and Primary Industries) should be instigated by the researchers if the spatial planning research was to achieve prominence within their target organisations.

Participants from one government department nominated their seminar series as an appropriate place for researchers to present their results to a wider audience. A drawback to this option, however, was that seminars in the department concerned were historically poorly attended. This low attendance might originate from a lack of interest and/or opportunity, and represents a barrier to not only the dissemination of the spatial planning research but the Departments capacity to facilitate interactions with researchers and other stakeholders.

Should high-level contact be formed with the relevant departments and organisations, one participant believed that these "champions" could coordinate forums that targeted current issues. Other participants were interested in organising a seminar involving their spatial planning officers prior to the reports completion, but noted that time would need to be invested in its preparation. Therefore, despite the lack of confidence in their existing seminar series (due to historically poor attendance) seminars seem to be an acceptable means of research dissemination for some participants if they are organised using high-level insiders and planned and promoted well ahead of time.

Re-packaging research

One participant felt that it was premature to disseminate the research in its current form. This individual believed that the current technical report only sketched a rationale and a draft provision and that it needed to be re-packaged despite their being no budget to do this beyond the present project timeline. Other participants stated that the research needed to be condensed into clear messages about policy implications that were also backed-up by more detailed documents. Others suggested that a table of contents be prepared which included a detailed summary of each section. These remarks suggest that participants recognise that the workshop was primarily attempting to obtain information that would enable knowledge that was not co-produced to be reconfigured in ways that heighten its salience, credibility and legitimacy.

Some participants identified areas in the technical paper where particular issues needed to be more fully recognised and discussed. One such issue was the increased bushfire potential resulting from certain resource management practices. Another related issue concerned planning regimes that allowed residential areas to border National Parks. Participants also wanted to see in the report more attention afforded to the acquisition or buyback of land in bushfire prone areas.

Other more informal positioning strategies were suggested by participants. For example, publishing easy-to-digest articles in professional magazines (e.g., Planning News) might raise awareness about spatial planning issues and build community support. Two other participants suggested that the researchers look for small ways in which they can work to build community support, such as inviting select Deputy Secretaries to lunch where the research might be discussed in a relaxed and open fashion.

Workshop assessment

A range of benefits provided by attending the workshop were recognised by participants. Some of these benefits referred to obtaining knowledge about the legal aspects of spatial planning for

adaptation, while others focused more on the deliberative component of the workshop that involved knowledge sharing:

- Discussing ideas about how best to disseminate the research findings.
- Access to clear, relevant and interesting information about the planning tools applicable to climate change adaptation.
- Access to the latest research.
- Provided a rare opportunity to share ideas with colleagues.
- Clarified the non-statutory opportunities to progress spatial planning outcomes.
- Showed that the risk assessment that provides the basis for determining boundaries of spatial planning is still highly contested.
- The opportunity to make contact with the researchers about a range of other planning matters.
- Excellent facilitation and presentations.

Other comments provided by the participants reflected the value of the research experience rather than participation in the workshop:

> [Relevance] … this is the first VCCCAR project that has touched on the role of my Department in anything other than a very marginal way.
>
> [Intelligence] … the sense that the structured approach has been understandable and it has provided much needed legal "intelligence".
>
> [Collaboration] … our involvement has been meaningful and appreciated. It means a lot of work for the project team, but should lead to more implementable outcomes.

Finally, participants offered comments about VCCCAR and its role in supporting collaborative research. Participants believed that the absence of VCCCAR would limit the use of the research given the organisation's role in brokering research relationships across the research and policy spheres. Participants from one department believed that the spatial planning project was the VCCCAR project that had the most relevance for their department and the one that had been the most collaborative. One participant believed that co-production was done badly in Victoria which they felt underlined the continuing need for VCCCAR.

Participant observation results

Government officers were asked what aspects of the spatial planning results had particularly resonated with them, given the roles and functions of their respective departments. This discussion revealed that there were topics and themes of interest across many, if not all, of the departments and agencies. The following six topics were identified:

1. Embedding consideration of climate change in legislative frameworks and governance arrangements;
2. Engaging ports in climate change adaptation;
3. Critical infrastructure and climate change;
4. Dissemination and application of hazard information;
5. Climate change and legal liability: Considerations for government;
6. Governance models for adaptation: Planning law and related measures.

Government officers were keen to use the policy briefs in the following manner:

- Repackage in internal briefs and memos

- Use to drive change/ get buy-in internally
- Demonstrate academic rigour and research around these issues/options
- Generate interest for internal briefings by researchers
- Target areas where the research and findings can be directly applied – eg into draft strategies
- Identify areas for further research
- Highlight key messages, and can refer interested parties to detailed technical papers if required.

The policy briefs were well received suggesting that they aligned with the needs of the relevant organisations for which they were designed for. The following stakeholder comments make favourable references to particular briefs and technical papers and demonstrate that these project outputs were regarded as providing information that was relevant and applicable to the organisations concerned:

> "[The policy brief] provides very useful context on this subject and I think it'll help with the Ministerial Guidelines on Port Development Strategies. I think it'll also be of interest to colleagues dealing with SEMPs for local ports and will share with them."
>
> "There is a real opportunity here for us to build on the programs and projects of agencies whose primary, legislative responsibilities are to educate about hazards. This could be the lever we have been looking for to streamline climate adaptation into emergency management. In particular, the last para in this brief (Hazard info as a driver for adaptation) is particularly relevant as it is aimed at individual, household level responsibility. There should be the opportunity to take this paper further once our office restructures."
>
> "It is very useful to have the suite of [the spatial planning] papers so that there is detailed information ready to use if and when opportunities arise within government to explore/apply them."

Some government officers sought answers and solutions to specific problems within their departments, but it was not part of the spatial planning project to provide legal advice. However, a focus of preparing the series of briefs was to deliver, where possible, options or opportunities that government might choose to aid climate change adaptation efforts.

Similarly, some stakeholders wanted explicit action items (e.g. drafting instructions for legislation) whereas others specifically did not want action items or even recommendations (i.e., they would only accept 'options/opportunities'). Clarity and consensus around outcomes would be useful for future research projects between government and academia.

Of further interest was the way in which some policy professionals served as gate-keepers to their organisation in that they acted to control the progress of the research results and engagement with their executive. This notwithstanding, most stakeholders wanted much broader inclusion of colleagues and management.

Discussion

The results suggested that understandings of the research process among policy professionals might be as naïve as researchers' understandings of the policy process are believed to be (Weiss, 1979). That is, there was an instrumental research-to-policy expectation among some of the policy professionals that participated in the workshop. This expectation mirrors that among academics who conceive of policy-relevant knowledge as emerging from a narrowly focused, linear research

process. One Department adopted what Weiss described as a "problem-solving" understanding of research:

> Here the decision drives the application of research. A problem exists and a decision has to be made, information or understanding is lacking either to generate a solution to the problem or to select among alternative solutions, research provides the missing knowledge. With the gap filled, a decision is reached. Implicit in this model is a sense that there is a consensus on goals. It is assumed that policy makers and researchers tend to agree on what the desired end state shall be. The main contribution of social science research is the help identify and select appropriate means to reach the goal. (p.427)

According to Weiss (1979) the model makes the heroic assumption that because the research was inspired by a real world problem, the research outputs will fill the existing knowledge gap. This expectation is optimistic and most problem-solving research fails to influence policy because there are too many factors that must be present for a direct impact to occur. For example, the solution of the problem must be amenable to information to some degree, the information must be unambiguous and match the context in which it is to be applied, the information must be delivered at the time policy-makers are dealing with the problem, and those applying the information must have the power to do so. According to Weiss, it is unlikely that these types of conditions all align around a single policy problem. This might explain why some participants felt that research outputs commissioned by their organisations were not always applicable to the policy issue at hand.

Weiss (1979) suggested that because people tend to understand research in terms of the problem-solving model, there is the risk that they get despondent when it fails to meet their expectations. The sorts of outcomes that can be achieved under different kinds of research arrangements needs to be understood and agreed upon by researchers and policy-makers. In this respect, policy-makers need to be introduced to a wider range of models for conducting research, especially those practices and outputs characteristic of post-normal research. In addition, policy professionals will need to be willing to collaborate in the research process rather than defer to researchers who may be protective of their traditional role as principal knowledge producer. Having a clear view of what co-production is, and what might be achieved through it, might provide opportunities and motivation to participate in post-normal research activities.

It was found that research articles may not be a very frequently used resource in decision-making. When research information does get recognised, it has been scrutinized for relevancy to the issue at hand, the legitimacy of the results, and its practicality. These criteria, while not exactly aligned with those of Cash et al. (2003) nonetheless reveal a research assessment process that uses concepts that are similar to the ones they described:

> Credibility involves the scientific adequacy of the technical evidence and arguments. Salience deals with the relevance of the assessment to the needs of decision-makers. Legitimacy reflects the perceptions that the production of information and technology has been respectful of stakeholders' divergent values and beliefs, unbiased in its conduct, and fair in its treatment of views and interest. (Cash et al., 2003, p.8086)

It is not clear from the data what meaning these sorts of criteria have when applied, and whether their meaning varies with different types of research (e.g., applied versus basic research; empirical research versus literature review; economic research versus engineering research, etc.) different

types of policy issues, and different institutional settings. Simply put, what constitutes "legitimate," "practical," and "relevant" research results? This might be the focus of future research and one which is also amenable to co-production.

The apparent use of concepts pertaining to the quality of research results is encouraging for the dissemination of the spatial planning research given the position afforded such assessment processes in the model of knowledge use in Waylen and Young (2014). Recall that research results that are deemed credible, salient and legitimate are more likely to be used instrumentally in decision-making. Therefore, there are likely to be opportunities to increase dissemination by demonstrating that the spatial planning results fulfil such criteria.

Most of the participants in the workshop appeared to regard the spatial planning research as being good quality and of value, and the researchers' analysis was not criticised. However, some participants did want to see the research results presented in a more accessible form and tailored to their own organisational contexts. This re-focusing of research results is consistent with Jordan and Russel (2014) who noted the importance of recognising that the same research results may need to be communicated differently depending upon the policy formulation context or "venue" involved:

> These venues can … have a marked impact on the patterns of use and nonuse … For example, they may each have specific models of processing and utilising knowledge based on their standard operating procedures and accepted framings of policy problems. (p.194)

The spatial planning researchers and policy professionals decided upon producing a series of policy briefs that were targeted to the needs of each department. These re-packaged outputs benefited from co-production given that their utility depended upon assessments undertaken by the potential users. In fact, the policy professionals were found to want to use the policy briefs in a number of ways. These uses included assisting with operational issues (e.g., generating draft strategies in targeted areas) to building awareness within and outside their organisations, and informing future research agendas.

From the perspective of Waylen and Young (2014), knowledge use is improved by effective facilitation of opportunities for social learning and relationship-building. The workshop data suggest that departments and universities might do more of this kind of facilitation. However, as discussed above, the seminar series in one department suffered from poor attendance. An exploration of the reasons behind this seems to be warranted with the aim of improving attendance. For example, if time constraints limit participation, a small symposium held once or twice a year might be a more appropriate forum for knowledge sharing (potentially leading to use).

The importance of champions and enablers to increase the salience, credibility and legitimacy of research (improving the potential for knowledge use) is recognised by Jordan and Russel (2014) and Nutley et al. (2007). Facilitation might have been used to create opportunities to find potential champions for the spatial planning research.

In the workshop, participants offered formal and informal ways in which dissemination and interaction might occur, including publication of accessible articles in professional magazines, and the establishment of more informal lunch meetings. (It has been suggested that workshop

participants could have been provided with a list of dissemination/interaction methods as a prompt.) Nevertheless, any activities would need to be supported by both policy and research organisations if individuals are going to participate in a sustained manner. For example, universities may devalue articles that are not published in peer reviewed publications. This need for boundary work to be coordinated by boundary organisations underscores the importance placed by participants on VCCCAR.

Finally, the workshop methodology used in this research was viewed positively by the participants involved. Specifically, participants obtained access to relevant, interesting and current research on spatial planning and learned from the experience. Furthermore, participants increased their networks by making contact with researchers and other participants and to share ideas in an environment that was facilitated well by the organisers. There were no indications from participants that they had not received enough information about the spatial planning research or its results, or that their participation had been constrained by workshop procedures. These observations speak to the validity of the data and conclusions presented here.

In conclusion, a number of strategies for improving the up-take of research results were identified by policy professionals participating in the workshop, including:

- re-packaging the spatial planning results into products tailored to each intended user
- build support for the research results by recruiting influential champions
- build support for the research by publishing/presenting the results in professional fora and publications
- influence departmental agendas by engaging directly with senior department staff
- improve research commissioning and management by introducing policymakers to the potential benefits of flexible research models that foster realistic expectations
- review the manner in which research is obtained and assessed, to improve the application of evaluation criteria and introducing better research products
- recognise that employee roles can constrain research use at different organisational levels, and review research communication
- increase opportunities for stakeholders to learn from each other through well-planned seminars, symposia, etc
- support a research enabling unit or organisation to facilite boundary work.

These strategies were placed in the context of a model of knowledge use with the purpose of informing the methodology reported here and organising the interpretation of the data rather than evaluating the model itself. This process highlighted dissemination both formal and informal strategies that might be further developed by the researchers, policy professionals and organisations involved in the spatial planning project.

General discussion

The workshops, coproduction meetings and policy briefs developed by the projects discussed in this report were introduced (partly as a result of the Research-into-Policy project) in an effort to increase the likelihood of research use in the policy and practice spheres. On the basis of data from the three case studies, we have identified a number of strategies likely to increase instrumental, conceptual and/or strategic use of research results. These strategies can be described as facilitation, interaction or dissemination strategies as suggested by Waylen and Young (2014).

In fact, these strategies were found to be closely linked, given that research products such as policy briefs require the conditions for collaboration between researchers and policy-makers, and good communication processes such that the results are tailored to the potential users and uses. The range of knowledge use strategies drawn from the case studies are summarised in Table 2 under the headings of facilitation, interaction and dissemination although some strategies straddle more than one domain.

Table 2. Knowledge use strategies arising from the case studies

Facilitation strategies
• Enable the range of potential stakeholder interests to be represented in the framing of research and in the production of research outputs (e.g., through public involvement mechanisms and the application of fair participation processes). • Provide opportunities for potential users of research results to meet and discuss how the research might be applied (e.g., presentations to relevant committees, community workshops). • Use a boundary organisation to create the space in which researchers, policy-makers, and other relevant interests interact. • Recognise that employee roles can restrict individual autonomy to use research results.
Interaction strategies
• Support individuals engaged in boundary work with technical, financial and leadership support. • Manage personnel changes as they limit effective communication and relationship-building between organisations and groups. • Improve the system of commissioning and managing research by introducing policy-makers to the potential benefits of flexible research models that foster realistic expectations. • Recognise that successful communication between key individuals involved in collaboration and co-production requires face-to-face meetings and personal qualities such as enthusiasm, commitment, trustworthiness, and good interpersonal skills.
Dissemination strategies
• Co-produce research products that are tailored to the specific uses, users, and policy context. • Understand the manner in which research is deemed to be 'useful' by users and determine how this criteria can be met or improved upon. • Build support for the research by publishing/presenting the results in professional fora and publications. • Build support for the research results by recruiting influential champions to speak for it.

What kinds of strategies for which projects?

The case studies demonstrate some common strategies, such as disseminating research results in formats that are likely to be accessible and applicable to the intended users. However, some types

of strategies were more specific to particular case studies. For example, knowledge use strategies identified in the decision-taking workshop in Gippsland seemed to be primarily about developing relationships and more inclusive decision-making procedures, rather than dissemination strategies (although the development of decision-making guidelines has been discussed).

In the spatial planning project, in contrast, strategies tended to be about dissemination (although some strategies were also about interaction and facilitation). Of course, the decision-taking project showed that interaction structures and processes that were important for regional planning were somewhat undeveloped or absent. The range of stakeholders was also quite broad, involving community groups, non-government organisations, government bodies and private sector interests. The range of interests in the spatial planning and water infrastructure projects, on the other hand, were arguably narrow and the relationships among stakeholders were reasonably well-developed when compared with the whole range of interest groups included in the decision-taking project. Therefore, consistent with the Waylen and Young (2014) model, facilitation strategies were found to provide a foundation upon which interaction and dissemination activities can be built to bring about the various kinds of knowledge uses.

Of the different strategies that were identified in the research, four basic conditions for the promotion of knowledge use can be identified. These conditions are: An authorising environment; Addressing power inequalities; Raising awareness and building support; Tailoring results to the needs of users.

An authorising environment

There were a number of opportunities for researchers and policy professionals involved in the water infrastructure project to meet face-to-face to plan, prepare and present the policy brief to senior departmental executives. The positive authorising environment of the government research partners meant that they were able to champion the research development and outputs to good effect. Moreover, the facilitation of these activities on a regular basis with the necessary resourcing in terms of people and time was necessary for the research results to be presented in a new way.

The policy brief from this project, and those from the spatial planning project, were research outputs that benefited most from co-production activities. In the former case, the data showed that the policy brief was received well in the policy realm. It's possible that the opportunity afforded the researchers to present the brief to key policy-makers also contributed to its success and its use. However, the data do not enable a detailed analysis of the processes involved.

Similarly, an assessment of the decision-taking policy briefs is not possible as they were being produced at the conclusion of the research-to-policy project. Future research could assess different knowledge use strategies within research designs to enable comparisons between approaches. The co-production of policy briefs, nonetheless, seems to hold promise for increasing the likelihood of research results being accessed and used in the policy sphere.

Addressing power inequalities

Some participants pointed to the history of power dynamics operating within the social, historical and political context in which the research results were generated and intended to be applied. This was prevalent in the decision-taking project which arguably had a stronger basis in a specific social, political, geographic and economic setting than the other two research projects. However, power issues in a more narrow sense were also raised in the spatial planning project where the roles of participants within their organisations may limit their ability to influence executive decision-making and practices.

In both cases, it might be concluded that effective knowledge use requires an understanding of the broader social context (e.g., community structures, organisational cultures and structures) in which research results are introduced.

Raising awareness and building support

Use strategies aimed at raising awareness and building support were suggested in the decision-taking and spatial planning projects and, as noted in the literature review, they are also strategies identified in previous research (e.g., Adamo, 2003; Nutley et al., 2007). It should be recognised that the case studies examined in this project had progressed toward their final stages. Raising awareness and building support may be difficult to achieve when the targets of these endeavours are not also involved in earlier stages of the research cycle. Therefore, activities seeking to recruit champions, for example, are more likely to be successful if target individuals and organisations are included in discussions early in the research framing and planning phases.

Tailoring research results to user needs

In all three projects, suggestions were made or activities were undertaken to package the research results in ways that were likely to increase their appeal and use in policy. These suggestions included the development of policy briefs, fact sheets and articles in non-academic publications (such as professional newsletters etc). The packaging (or communication and dissemination) of research results, like building support, is an activity that would be better planned for earlier in the research process. In this way, outputs such as policy briefs would be identified as project deliverables rather than as supplementary 're-packaging' activities.

In conclusion, according to the data from the three case studies examined in this project, there are a range of activities that can be undertaken to increase the potential for use of research results. This is true even when the research has been initiated with minimal stakeholder consensus of how the results might be communicated, disseminated and used in the policy sphere. In one case, re-packaging the research results meant that they were used as an educational tool and to support a policy position in a major government inquiry.

One factor that seems to be important in how research results are used is the extent to which the conditions enabling effective communication and dissemination are apparent. When there are marked power inequities among stakeholders, poor communication processes, and opaque decision-making procedures, much more facilitation toward the development of trusting relationships and open communication is necessary for successful knowledge use.

References

Adamo, A. (2003). *Influencing Public Policy through IDRC-Supported Research: Synthesis of Document Reviews*. The Evaluation Unit, International Development Research Centre. IDRC: Ottawa, Canada.

Cash, D. W., Clark, W. C., Alcock, F., Dickson, N. M., Eckley, N., Guston, D. H., Jäger, J., and Mitchell, R. B. (2003). Knowledge systems for sustainable development. *Proceedings of the National Academy of Sciences, 10:* 8086–8091.

Funtowicz, S. O. and Ravetz, J. R. (1993). Science for the post-normal age. *Futures, 25*:739-755.

Gibbons, M. (2000). Mode 2 society and the emergence of context-sensitive science. *Science and Public Policy, 27*:159-163.

Guston, D. H. (2001). Boundary organizations in environmental policy and science: an introduction. *Science, Technology, and Human Values, 26*:399-408.

Hemsley-Brown, J. (2004). Facilitating research utilisation: A cross-sector review of research evidence. *The International Journal of Public Sector Management, 17*:534-552.

Ison, R., Blackmore, C., and Iaquinto, B. L. (2013). Towards systemic and adaptive governance: Exploring the revealing and concealing aspects of contemporary social-learning metaphors. *Ecological Economics, 87*:34-42.

Jordan, A. and Russel, D. (2014). Embedding the concept of ecosystem services? The utilisation of ecological knowledge in different policy venues. *Environment and Planning C, 32*:192-207.

Jung, T., Nutley, I. S., Morton, S. and Millar, A. (2010). Linking research and policy in Scotland. *The Policy Press, 6*:213-235.

Kirchhoff, C. J., Lemos, M. C. and Dessai, S. (2013). Actionable knowledge for environmental decision making: Broadening the usability of climate science. *Annual Review of Environmental Resources, 38*:393-414.

Landy, R., Amara, N. and Lamari, M. (2001). Utilization of social science research knowledge in Canada. *Research Policy, 30*:333-349.

Milman, O. (2013). Top 20 things politicians need to know about science. The Guardian, November 21. http://www.theguardian.com/science/2013/nov/20/top-20-things-politicians-need-to-know-about-science

Nutley, S. M., Walter, I., Davies, H. T. O. (2007). *Using Evidence: How Research Can Inform Public Services*. Policy Press: Bristol.

Owens S. (2005). Making a difference? Some perspective on environmental research and policy. *Transactions of the Institute of British Geographers, 30*:287-292.

Reed, M. S., Evely, A. C., Cundill, G., Fazey, I., et al. (2010). What is social learning? *Ecology and Society, 15*:1-10.

Rich, R. F. (1997). Measuring knowledge utilization process and outcomes. *Knowledge and Policy, 10*:3-10.

Richardson, T. (1996). Foucauldian discourse: Power and truth in urban and regional policy making. *European Planning Studies, 4*:279-292.

Ridaelli, C. M.(1995). The role of knowledge in the policy process. *Journal of European Public Policy, 2*:159-183,

Sutherland, W. J., Bellingan, L., Bellingham, J. R., Blackstock, J. J., et al. (2012). A collaboratively derived science-policy research agenda. *PLoS ONE, 7*:1-5.

Sutherland, W. J., Spiegelhalter, D. and Burgman, M. A. (2013). Twenty tips for interpreting scientific claims. *Nature, 503*:335–337.

Taylor, M. (2011). *Public Policy in the Community (2nd edition)*. Basingstoke: Palgrave MacMillan.

Tebes, J. K., Thai, N. D. and Matlin, S. L. (2014). 21st Century science as a relational process. From Eureka! To team science and a place for community psychology. *American Journal of Community Psychology, 53*:475-490.

Tyler, C. (2013). Top 20 things scientists need to know about policy-making. The Guardian, December 3. http://www.theguardian.com/science/2013/dec/02/scientists-policy-governments-science

Vogel, C., Moser, S. C., Kasperson, R. E. and Dabelko, G. D. (2007). Linking vulnerability, adaptation, and resilience science to practice: Pathways, players, and partnerships. *Global Environmental Change, 17*:349–364.

Waylen, J. A. and Young, J. (2014). Expectations and experiences of diverse forms of knowledge use: the case of the UK National Ecosystem Assessment. *Environment and Planning C, 32*:229-246.

Weiss, C. H. (1979). The many meanings of research utilization. *Public Administration Review, September/October*:426-431.

Woolgar, S. (2000). Social basis of interactive social science. *Science and Public Policy, 27*:165-173.

Zinn J. and Fitzsimons P. J. (2014). *Decision Taking in Times of Uncertainty: Towards an efficient strategy to manage risk and uncertainty in climate change adaptation. Final Report*. Victorian Centre for Climate Change Adaptation Research.

Appendix 1: Spatial planning workshop questionnaire

How Was It For You?

1. How valuable was today's workshop in identifying ways in which the spatial planning research can be utilised within your department? (Please explain what worked and what didn't.)

2. Are there better ways to share this research that would promote its uptake within your department?
   (Please note these below and explain their advantages.)

3. Is there anything else you'd like to add regarding today's workshop?
   (Please attach additional pages if required.)

Appendix 2: Decision-taking workshop agenda

Meeting to discuss the findings of the VCCCAR project *Decision Making in Times of Uncertainty* which aimed to build our knowledge of decision making in complex strategic planning processes and identify key issues for climate change adaptation.

9.30am – 1.00pm Friday 30 May 2013

Conference Room, Victorian Business Centre, 33 Breed Street, Traralgon

TIME	ACTIVITY
9.15-9.30	**REGISTRATION, TEA AND COFFEE**
9.30-10.15	**SESSION 1. WELCOME AND PRESENTATION** Project outline and key findings for Decision Making in Times of Uncertainty. (Speakers – Project Leaders Jens Zinn and Patricia Fitzsimons)
10.15-10.45	**SESSION 2. DISCUSSION OF FINDINGS** Contributions are invited from participants for a general discussion on the findings focussed on identification of surprises/validation of own knowledge and its specific relevance for the Latrobe Valley/Gippsland. (All Participants)
10.45-11.00	**MORNING TEA**
11.00-12.00	**SESSION 3: A REGIONAL PERSPECTIVE ON DECISION MAKING** Participants to spend 5-10 minutes writing a response to: (1) What would you understand as good regional decision-making? (2) How can decision-making be effective in the face of uncertainty? (3) How would I recognise it? Each participant to share their response, followed by a group discussion focussed on: (1) What do we understand as the key findings? (2) What are the implications for regional decision-making? (3) What are the main barriers to decision-making? (4) How can these outcomes be used in the future and by whom? (All Participants) - followed by a short break, then regroup into two tables
12.00 – 12.30	**SESSION 4: AN ONGOING VISIONING PROCESS** A process that incorporates conversation mapping and a visioning exercise to identify a (new) future for the Latrobe Valley. (All Participants)
12.30 – 13.00	**SESSION 5. INCORPORATING GROUP OUTPUTS INTO FUTURE RESEARCH & NEXT STEPS** Facilitated discussion about next steps (Facilitated by Jens Zinn and Patricia Fitzsimons)
13.00 - 13.30	**LIGHT LUNCH**

Appendix 3: Water infrastructure project policy brief

http://www.vcccar.org.au/publication/policy-brief/evaluating-investment-projects-under-risk-and-uncertainty

vcccar
victorian centre for climate change adaptation research

Policy Brief

April **2014**
Climate Adaptation for **Decision-makers**

Evaluating investment projects under risk and uncertainty

Contributors
Harry Clarke, Shanti Gadde, Alain Baillie and Rod Keenan

Key points

- The timing of investment for infrastructure projects, and the payoffs or costs from delaying these projects, are important. Waiting to invest in a project means planners can improve their ability to learn about likely payoffs in a situation where these payoffs are initially imperfectly known. Irreversible investment commitments must clear more stringent net benefit hurdles to be undertaken immediately than is the case using standard cost-benefit analysis.
- Climate change presents particular challenges for investments that depend on climate related inputs, such as rainfall, because it adds additional uncertainty.
- Given possible value of waiting increases as learning about payoffs increases, there can be a case for deferring a project even if the current net expected benefits from the project are positive because there is an option value placed on improved information that can be gained in the future.
- If this option value is ignored, implementing standard cost–benefit approaches can lead to overinvestment in infrastructure because the full benefits may never be realised. However, there is an inherent trade-off between the enhanced flexibility from delaying a large project and the certainty gained from early implementation. Society is generally risk-averse when it comes to water security, leading decision makers to prefer early implementation, even if there are significant financial implications.
- The case for delaying large water augmentation projects therefore needs to be strong, with reliable back-up water sources and management policies available in the interim.
- Using auxiliary policies, strategic planning or modular design options can improve outcomes where there is risk and irreversibility, because:
  - » Auxiliary policies can 'reduce the costs of waiting'. They include increasing the prices of commodities such as water when they are in low supply to reduce demand to lengthen their availability;
  - » Strategic phasing for large investment projects can reduce implementation time and costs when the future investment decision is made; and
  - » Modular design options that can allow smaller initial infrastructure investments to be built and then possibly scaled up as the future situation becomes clear.
- Introducing risk aversion into project evaluation modelling changes the analysis markedly. If failing to deliver an infrastructure project could result in severe social losses or, equivalently, if decision-makers were judged to be highly risk-averse.
- Real option approaches can improve on traditional cost–benefit analysis for analysing risky irreversible investments.

Introduction

The Enhancing Water Infrastructure Provision with Climate Change Uncertainty project investigated the use of alternative economic models for evaluating large public infrastructure investment projects (e.g. a desalination plant) when there is risk and uncertainty, and assesses appropriate policy options for water utilities, regulators and other government agencies. This brief presents a portion of the research relating to project evaluation. Insights can improve decisions relating to investment in water-supply infrastructure by accounting explicitly for climate variability and for prospective climate change. These insights can be applied to other capital-intensive long-term investment projects undertaken by government.

Real options analysis can change the way planners think about evaluating investments in infrastructure under conditions of risk. This approach targets irreversibility, risk and risk aversion. These are typically very practical considerations. This Policy Brief draws out the key insights from these theories and illustrates the main ideas by taking the example of building a desalination plant for urban water supply. Risk and irreversibility coupled with learning provide a case for more caution and delay even where conventional cost–benefit analysis might not suggest this.

Real option approaches typically assume risk neutrality, therefore decision-makers seek to maximise the expected value of investments. However, high risk-aversion can create a case for decisive early investment.

Imperfect knowledge can be characterised in several ways. **Risk** describes situations where decision makers know all the possible outcomes that can occur and can assign probabilities to the various events. **Uncertainty** describes situations where the outcomes are known but the probabilities attached to these outcomes are entirely unknown. **Gross ignorance** describes situations where there are "unknown unknowns" – where outcomes can occur that were not even initially envisaged.

Real options analysis requires probability information and hence is based on situations of known risk. This probability information may not be readily available so it is also important to consider techniques for discussing situations of uncertainty and gross ignorance are also discussed.

When to consider real options techniques

Irreversibility, risk and the possibility of learning about such risks are key factors motivating use of a real options approach to evaluating investment decisions. They are described below:

- **Irreversibility**
  An investment is irreversible if, once capital is invested, it cannot easily be redirected to an alternative use. This characterises most infrastructure investments. Roads, highways, bridges, dams, airports, water supply facilities and train lines have very limited possible alternative uses beyond the purpose for which they were originally designed.
- **Risk**
  The long time horizon of many infrastructure investments means that decisions are made in the context of recognised risks about future costs and benefits. Although we do not know for certain how the construction and other associated costs will be subject to the weather and other factors, including labour costs, technological improvements and efficiencies, and future energy pricing during its operation, we do have the knowledge and capability to model these through time to assist our decision making.

The value of learning

For policy makers to be able to derive advantage from using a real options approach, information about the risks associated with a project must improve over time. The rate of this learning needs to be commensurate with the timing of future decision points.

For example, in the case of a desalination plant, the benefits from the project will depend on the future value of the water sold, which will in turn depend on the evolution of the demand for water, the availability of water from sources such as dams and aquifers and the feasibility and cost of purchasing water from other sources or users. Future aggregate water demands will also depend on demographic factors such as population size and age structure and water consumption characteristics. Future values are by their nature highly uncertain but these values become generally better known as the future unfolds.

For climate-related variables, investment in research could result better understanding of historical climate variability or greater confidence in the capacity to predict future conditions.

Reducing the costs of waiting

While waiting for better information, there are a range of approaches that can be considered before committing to full investment. These measures improve the flexibility of investment decision-making by enhancing the capacity to delay project initiation. See Clarke (2014).

- **Auxiliary policies**
  Auxiliary policies can reduce the costs of waiting and improve the economics of the investment. For example, an auxiliary policy for urban water supply might price water higher when water storages are low ("scarcity pricing"), hence reducing water demand and thereby enabling the postponement of major capital investment. Other options might include integrated water cycle management or investment in research and development on water consumption and efficiency measures.

- **Modular design**
  Modular design can replace all-or-nothing construction decisions for large-scale investment projects. For example, a smaller scale facility can be built to be scaled-up if future conditions require it. This may mean that potential economies of scale are not realised. Pilot-scale plants can provide cost information, which may be particularly important if facilities that are being contemplated have no similar local/ national comparison projects constructed in Australia.

- **Strategic phasing**
  Where possible, the implementation of large capital investment projects should be phased into discrete standalone components with those generating the highest overall benefit to society being implemented first. By way of example, before fully investing in a large scale infrastructure development such as carbon-capture and storage (CCS) technology, it might be more cost-effective to first investigate and develop a new regulatory and legislative framework that is required for CCS. Even if the full investment does not proceed, the benefit of this work will reduce the costs of undertaking CCS for future decision makers or if there is later private sector interest.

When to defer investment

A crucial component of the real options approach is that planners learn more accurately about the future state of the world as time proceeds. Thus, if an investment is deferred, planners may be in a better position to make such judgements about the true state of the world. The benefits from such delays need to be assessed against the costs of not gaining immediate output benefits from the project.

In the desalination plant example, this might mean that over time we obtain better information on how climate change is associated with worsening droughts. Typically, for urban water planning, if we wait to invest there will also be better knowledge of variables such as demographic changes and the success of water conservation efforts — and hence of aggregate water demands.

Predicting future water availability in a changing climate is particularly challenging. On a continental basis, rainfall trends have high inter-annual variability so that that isolating the effects of gradual climate change might be statistically difficult. . The confidence around projections for local areas is also lower than for larger regional areas.

Risk does not need to be completely resolved for learning to delay the final decision to proceed with the investment. However, if a planner is confronted with exactly the same risk assessment in the future as today, then there is no benefit from waiting or investing in learning. The decision can be made immediately on the basis of expected returns.

The most important issues are whether the project should be started now or deferred, and the desired project scale. For the investment to proceed, the calculated expected benefits, of the project must exceed the expected costs. Otherwise, it would always make sense to defer. Thus, the investment decision is whether it makes sense to defer, even though expected net benefits are positive. When should construction begin immediately?

The key insight of the 'real options' approach is that there can be a case for deferring a project even if the net expected benefits from the project, calculated now, are positive, because under uncertainty there is a benefit to waiting to gather further information.

Intuitively, because embarking on the investment is irreversible, there are unavoidable ongoing costs. However, not starting the project now is a decision that can be reversed. If say, in some future time period, improved or stronger evidence is forthcoming, then the initial decision not to build the plant can be reversed and construction can proceed in the future. If present expected benefits from proceeding are significantly greater than expected costs, then waiting to access new information may be worth less than proceeding now.

The standard rule of cost–benefit analysis is that a project should proceed when the expected, discounted benefits from a project (EB) exceed the expected costs (EC).

Real options theory shows that applying such rules can lead to less expected net present value when investments are irreversible and risky, and when a planner's knowledge of the risks can improve, through learning, with time. The rule for not delaying investment in the model outlined is:

$EB > EC + QOV$

where QOV is the 'quasi-option value', a positive number reflecting the expected value of the extra information obtained from waiting to invest. Since QOV is positive, this rule is stricter than using the standard approach of replacing random variables with their expected values. Clarke (2013) discusses calculating the QOV in a simple setting.

Insurance against climate change impacts

The standard real options model developed does not consider risk aversion. Planners may seek to avoid risks of extreme shortages for essential goods and services. They might seek to insure against such risks. For example, water customers might willingly pay a premium to reduce the likelihood and duration of water shortages.

Risk aversion

An example of risk aversion is the annual premium a householder pays to insure their home contents against theft. This is paid even though the cost per year of the policy exceeds the expected value of any possible theft. For example, in a low-crime neighbourhood with only a negligible (e.g 1 per cent) chance of a theft worth $80,000, the householder might still pay $1000 insurance because a loss of $80,000 would be extremely damaging for them.

The difference between the cost of the householder's policy and the expected claim is $200; this amount measures the insurance premium. The decision to insure generally depends on the insurance premium charged relative to the risk, the costs consequent to the risk and the householder's degree of risk aversion.

The same idea applies to infrastructure projects. The extent of risk aversion reflects the amount planners will pay to avoid critically low levels of water supply.

Project evaluation techniques can be adapted to assess risk aversion by attaching a relatively high value to assuring delivery of a commodity (e.g. water) if there is a risk that it might become scarce. This value might reflect the judgement of planners or the planners might infer it from the behaviour of consumers, who might be induced to pay extra to avoid low supply.

This leads to a distinctive way of thinking about the cost of a technology such as desalination. Water supplied by a desalination plant might be more expensive to deliver than water supplied by rain-fed dams. But rain-dependent water supplies are subject to drought risk, whereas desalinated water is not. Thus, by providing a rain-independent source of water a desalination plant can be considered akin to taking out insurance against the prospect of drought that threatens to leave a community severely short of water in the event of extended drought.

When might the insurance premium paid for desalination be too expensive? This is difficult to judge without knowing the risk attitudes of planners and the community they serve. Insuring against the risk of inadequate rain does not address risk aversion towards other possible risks, such as increased energy prices, which might bear substantially on a technology such as desalination. Such risks come into greater prominence when a rainfall-independent technology, such as desalination, is already in place.

Examining the extra cost that desalination options imposed on state economies over cheaper rain-dependent options gives indirect evidence on this issue. The Productivity Commission (2011) estimated that the extra cost Melbourne and Perth paid for desalination was $2.1 billion over 10 years. For current populations in these cities over 10 years, the average price is $38 per person per year. Considered in this way, depending on attitudes to risk and the concern over shortage, households (of four people) might willingly pay $152 per year for insurance against severe water shortages arising from future climate change. The Productivity Commission thought this extra cost was excessive, but it is an issue of judgement.

Other methods to include values for 'the willingness-to-pay' for security of service supply can be determined using approaches in environmental economics (Kolstad, 2011), which uses 'stated preference', 'contingent valuation' or 'experimental economics' techniques. Cooper et al. (2013) estimate the willingness-to-pay of different groups of consumers for reduced probabilities of facing water supply restrictions in Sydney and Melbourne.

Real option versus heuristic[1] approaches

Both real option and cost–benefit approaches have, at their core, the idea that probabilities can be attached to different possible 'states of the world'/outcomes. Procedures then emerge for decision-making, based on maximising the expected payoffs from investments when risk is represented by such probabilities and when there is both learning and irreversibility.

In some cases it may be possible to determine or delimit probabilities using evidence. For example, historical records on rainfall and stream-flow data can help characterise future water supply. Even then the future water market is difficult to pin down, as the effects of climate change and water demands are driven by as-yet unspecified population policies. Urban water markets are characterised by uncertainties that are difficult to define using probabilities. For example, CSIRO (2008) estimates of climate change impacts on rainfall in the Murray–Darling Basin are highly uncertain — the report forecasts that future precipitation may fall within a range from 70 per cent higher to 70 per cent lower.

[1]Heuristic – a procedure for resolving decision problems using approaches that are plausible although not necessarily optimal.

Given that option pricing approaches are data- and technique-intensive, are there less-data intensive frameworks that can help decision-makers think through infrastructure investment planning?

Uncertainty

Where planners know the possible outcomes that can emerge but do not have even subjective probability information about the likelihood of these states, heuristics based on classical decision rules are useful. For example, application of the 'minimax criterion[2]' will result in an investment if it avoids the worst possible outcome imaginable - for example a city running out of water. This approach is related to the well-known "Precautionary Principle" (Chisholm and Clarke, 1993) often used to guide natural resource management.

Moreover, the minimax rule dictates not taking a decision if, in one state of the world, costly policy action would be ineffective. Policy in this situation would never be implemented because the worst outcome is that the adverse outcome occurs along with a costly failed policy. Unless the possibility of policy failure can be ruled-out the minimax criterion is implausible since it always involves recommending inaction.

'Minimax regret[3]' is an alternative heuristic. This involves calculating, for each possible investment option, the "regret" experienced defined as the difference between the cost incurred when undertaking an investment and the cost a decision maker would seek to incur once the outcome is observed. It suggests undertaking a policy when that action can avoid catastrophic consequences at relatively low potential cost.

This is the basis of the Intergovernmental Panel on Climate Change's (IPCC) case for global action to address climate change. Action should be taken because there are potentially catastrophic consequences of climate change (with trillions of dollars of consequent costs) and these can possibly be averted at relatively low cost (e.g. a small per cent loss of gross domestic product (GDP)).

This approach has appeal — it avoids very costly possible situations if this can be done at low cost. However, an implicit assumption is that the probabilities of the catastrophic events are not negligible, which invites arbitrariness.

[2]Minimax criterion - minimizing the maximum possible loss that could conceivably occur.
[3]Minimax regret - difference between the actual payoff and the payoff that would have been obtained if actual future outcome had been observed.

The minimax regret criterion has the attractive feature of focusing on extreme risks, for example, the (non-negligible) possibility that a city may have highly-restricted water supply. The criterion then seeks to consider inexpensive ways of avoiding such situations.

Since both the minimax and minimax regret heuristics do not use probability information they cannot involve any attempt to incorporate improved learning about such probabilities.

Gross ignorance

The most realistic situation to consider is the decision–problem where neither subjective probabilities nor an exhaustive understanding of other possible states of the world can be described. This is described as 'gross ignorance'. This situation is realistic though problematic. Therefore, it is important to anticipate that non-envisaged outcomes may occur, to avoid tunnel-vision theorising in making investment decisions and to adapt when making development plans by being prepared to reconsider plans that show evidence of being unsuccessful. This is difficult for large, individual public investment projects. It is therefore wise to consider scenarios where climate change is much more and much less severe than anticipated and to also consider situations where, as above, a policy failure may occur.

In these situations scenario-based approaches are a valuable tool for decision making. These support a shift from 'enhanced prediction' to 'robust decision making' under a range of potential future conditions. To maximise benefits of this approach, there needs to be a clear linkage between the scenario analysis and specific policy and program decisions. See more at: http://www.vcccar.org.au/adaptation-resources-for-decision-makers#sthash.LGGj60iW.dpuf

Conclusion

Learning with time or through experience is fundamental to the assessment of risky, irreversible investment projects under climate change uncertainty. Quasi-option values measure the extent to which planners should be conservative when assessing such prospects in situations when decision-makers are only concerned about expected returns. With risk neutrality, there is a case for making more cautious judgements than standard cost–benefit analysis suggests. If decision-makers are risk-averse then measures of their risk aversion provide the basis for quantitatively determining how much they will pay to avoid such risks. There could be a shift towards much less caution when undertaking investments.

In situations of uncertainty a number of heuristic decision rules can incorporate a focus on the issue of policy failure.

The research project team

Harry Clarke,
La Trobe University

Dr Jayanath Ananda,
La Trobe University

Professor John Freebairn,
The University of Melbourne

Dr Anke Leroux,
La Trobe University

References

Chisholm, A & H. Clarke (1993) "The Precautionary Principle and Natural Resource Management" in E. Dommen (ed) *Fair Principles for Sustainable Development*. University Press, Cambridge for UNCTAD, 109-122.

Clarke, H. (2014) "Evaluating Infrastructure Projects Under Risk and Uncertainty: A Checklist of Issuers", *Australian Economic Review*, 47, 1, 147-156.

Clarke, H. (2013) "Planning Urban Water Investments with an Uncertain Climate", *Economic Papers: A Journal of Applied Economics and Policy*, 32, 4, 426-439.

Cooper, B.,M. Burton & L. Crase (2013) "Exploring Customer Heterogeneity with a Scale Extended Latent Class Choice Model: Experimental Evidence Drawn from Urban Water Users in Sydney and Melbourne", Annual Conference of the European *Association of Environmental and Resource Economists*, Toulouse, France, 26-29 June.

CSIRO (2008) *Water Availability in the Murray-Darling Basin: A Report to the Australian Government from the CSIRO Murray-Darling Basin Sustainable Yields Project*, Commonwealth Scientific and Industrial Organisation, Canberra.

Productivity Commission (2011) *Australia's Urban Water Sector, Final Inquiry Report*, Canberra.

Victorian Centre for Climate Change Adaptation Research

University of Melbourne
221 Bouverie Street,
Carlton, Victoria, 3010
enquiries-vcccar@unimelb.edu.au
+61 (0)3 8344 3095
www.vcccar.org.au

Disclaimer: The views expressed herein are not necessarily the views of the State of Victoria, and the State of Victoria does not accept responsibility for any information or advice contained within.

© Copyright Victorian Centre for Climate Change Adaptation Research 2014.
ISBN:

Document available from VCCCAR website at:
www.vcccar.org.au/publications

Layout and design by Inprint Design
www.inprint.com.au

Appendix 4: Spatial planning workshop agenda

Aims:

1. To present the outcomes and recommendations from the spatial planning for adaptation research
2. To gather audience feedback and to identify what resonates with the different audience members with respect to their different departmental portfolios
3. To identify tools and strategies that would be needed to help disseminate the research into practice in the different departments and to plan possible first steps

	Activity	Lead	Timing
1	Welcome, introductions and outline/aims of the day	MB	9:30 am
2	Outcomes and recommendations from the draft paper · 'Formal' presentation	LG & AW	9:40 am
3	Audience feedback and identification of research outcomes/recommendations that apply/relevant to Department's portfolio · Introduction to co-production of knowledge project (LS) **5 minutes** · Small working groups (3-4 people: Departmental rep(s), lawyer, coproduction team) · Groups work through a set of questions (developed by LG and AW) to provide feedback and identify elements relevant to their departments **25 minutes** · Lawyers scribe · Broader group discussion **(last 5-8 minutes)**	MB	10:10 am
Morning tea break 10:50 am			
4	Dissemination strategy and plans for the different departments · Provocation on communication stratégies *(HF)* **5 minutes** · Small working groups (3-4 people: Departmental rep(s), lawyer, coproduction team) – *'how do we disseminate relevant research outcomes and recommendations within our portfolios?'* · Groups identify both broad dissemination strategies and tools, as well as immediate next steps/plans **25 minutes** · Co-production team scribe · Broader group discussion **(last 5-8 minutes)**	MB	11:00 am
5	Wrap up and next steps for each project (LG and LS)	MB	11:50 am

Appendix 5: Spatial planning policy briefs

Embedding consideration of climate change in legislative frameworks and governance arrangements

This policy brief highlights the tools identified in the technical papers *Managing the Risks of Climate Change and Natural Hazards* and *Governance and Legislative Issues for Critical Infrastructure Adaptation to Climate Change* (available on the VCCCAR website) that can be used to help embed consideration of climate change in legislative frameworks and governance arrangements.

The challenge is to mainstream climate change adaptation across government, private and community sectors so that it is fully integrated into business planning, risk management systems and operational programs.

Regulatory tools for considering climate change

Precautionary principle

The precautionary principle is well-entrenched in Australian and international environmental law. In Victoria it is found in legislation such as the *Environment Protection Act 1970* and the *Climate Change Act 2010,* as well as in regulatory instruments such as State Environment Protection Policies. The precautionary principle calls for actions to address serious or irreversible threats of damage to be implemented without delay, despite the absence of conclusive scientific proof of harm. Case law in Australia has articulated a two-part threshold test for application of the precautionary principle, both elements of which must be satisfied: (1) the existence of a threat of serious or irreversible environmental damage; and (2) scientific uncertainty as to the environmental damage.[2]

Integrated decision making

The complexity of potential adaptation risks and the possibility for their interaction emphasises the need for integrated decision-making processes to deal with this complexity. Different models and tools are available for improving the level of integration of climate change considerations into broader decision making exercises.

Court judgments

The Victorian Civil and Administrative Tribunal (VCAT) has dealt with several cases (detailed in the technical paper *Managing the Risks of Climate Change and Natural Hazards*) that explicitly raised the potential for climate change-exacerbated impacts and the role of the precautionary principle in addressing uncertainties and information gaps. The cases demonstrate how courts try to apply

[2] *Telstra Corporation Ltd v Hornsby Shire Council* (2006) 146 LGERA 10, at 38. These tests have been endorsed by the Victorian Supreme Court in *Environment East Gippsland v VicForests* [2010] VSC 335 and applied by VCAT in cases such as *Alanvale v Southern Rural Water* [2010] VCAT 480 and *Dual Gas v Environment Protection Authority* [2012] VCAT 308.

principles to actual facts. Government can use court judgments to inform policy and guidance documents to shape future directions.

Adaptive management

Another tool that exists to deal with information deficits and uncertainty is adaptive management. Adaptive management is often described as an approach of 'learning while doing' or 'policy experimentalism'.[3] An activity with uncertain impacts is allowed to proceed, but with systematic monitoring of results and feedback processes in place that allow ongoing decision adjustments.[4] For adaptive management to be effective, it is also critical that the regulatory framework under which decisions are made allows opportunities for adjustment. Laws that call for a single decision, not open to later reconsideration, will not provide a suitable institutional environment for adaptive management.[5]

Another way in which adaptive management might be put into practice is through the use of limited approvals for activities likely to be exposed to climate change risks over the long term. For example, approval for coastal development facing risks of sea level rise and inundation might be issued on the basis that buildings are capable of relocation at a future point in time. This allows the potential for reassessment of the sustainability of the activity at regular intervals, in light of emerging information regarding climate change risks.

Opportunities for government to embed climate change considerations

1. The *Climate Change Act 2010* is an example of an integrated decision making tool, as it specifies that climate change risks are a matter to be taken into account in decisions made under legislation dealing with other sectors. Section 15 of the Act requires decision-making under other specified (scheduled) statutes to 'have regard to' the potential impacts of climate change relevant to the decision. The current list of scheduled acts is limited.

   As the overarching and critical piece of climate change legislation in Victoria, this decision-making requirement could usefully be extended to other legislation, including the *Planning and Environment Act 1987*, which is the principal Victorian statute relevant for land use planning, the *Environment Effects Act 1978*, the *Transport Integration Act 2010* and other selected statutes. Extending the range of Acts scheduled in the *Climate Change Act* would be a very useful mechanism as it would give a legal underpinning to embed climate change considerations in decision-making processes.

[3] Carl J. Walters and C.S. Holling, 'Large-Scale Management Experiments and Learning by Doing' (1990) 71(6) *Ecology* 2060; Holly Doremus, 'Precaution, Science and Learning While Doing in Natural Resource Management' (2007) 82 *Washington Law Review* 547.
[4] Holly Doremus et al, 'Making Good Use of Adaptive Management' (Center for Progressive Reform, 2011).
[5] Jacqueline Peel, *The Precautionary Principle in Practice: Environmental Decision-making and Scientific Uncertainty* (2005, Federation Press, Sydney).

2. Risk management has become increasingly applied to climate change adaptation, given the significant uncertainty about future impacts and the inability to rely on historic data as a basis for current action.[6] The Victorian *Climate Change Act 2010* requires the preparation of a four-yearly Adaptation Plan that must be underpinned by the principle of risk management, and include a risk assessment.[7] The Victorian Adaptation Plan, in turn, recognises the need to embed climate change considerations into risk management and business planning for assets and critical service delivery across government portfolios.[8]

   The *Victorian Government Risk Management Framework* [9] (the Framework) is applied by government agencies to apply a common risk management standard as part of their business practices. Climate change is listed as one of many categories of risk in the Framework.[10] Careful monitoring should occur to ensure that climate change is, in practice, being incorporated into risk management and business planning across the government sector. As the Framework is designed for compliance by government agencies, consideration may be given to extending its reach to private entities by incorporating it by reference in contractual arrangements.

3. Government can shape the commercial agreements that it enters into with private entities, including infrastructure contracts, licensing and funding arrangements, and through these legal tools may incorporate terms that deal specifically with climate change risks and adaptation measures.

4. Consideration might be given to establishing a state government agency with the purpose of collecting, managing and disseminating climate change information across the public and private sectors. One entity (or a dedicated division of an existing department) could provide a focussed and streamlined data service. It could ensure that climate change information is distributed to those departments, agencies, local governments, businesses and communities where the information will be most relevant. The availability of a clearly available and accessible source of information may help develop a culture of considering climate change across a broad range of government, private and community sector decision making processes.

[6] Lee Godden, Francine Rochford, Jacqueline Peel, Lisa Caripis and Rachel Carter, 'Law, Governance and Risk: Deconstructing the Public-Private Divide in Climate Change Adaptation', 36(1) *UNSW Law Journal*, 224, 235.
[7] *Climate Change Act 2010* (Vic) ss 10 and 16.
[8] Victorian Government, *Victorian Climate Change Adaptation Plan* (March 2013) 10.
[9] Department of Treasury and Finance, *Victorian Government Risk Management Framework*, March 2011.
[10] Ibid 25.

Dissemination and Application of Hazard Information

This policy brief highlights the issues identified in the technical paper *Managing the Risks of Climate Change and Natural Hazards* (available on the VCCCAR website) that concern the dissemination and application of natural hazard information.

Laws and institutions can be shaped to facilitate or require the collection and distribution of information. They can also require information about climate change risks to be embedded in policies and practices to enhance the level of adaptation decision making by individuals, businesses and governments.

As climate change alters the frequency, intensity and likely location of natural hazards, it is important that information governance arrangements have the fluidity to respond to new data and inject that clearly into the public arena.

Roles and responsibilities

There is a role for government to perform in collating and disseminating climate related data to the private sector and other levels of government. This would provide consistent and current information across sectors. To provide greater clarity to the governance of climate change information, consideration might be given to establishing a state government agency with the purpose of collecting, managing and disseminating such information across the public and private sectors. One entity (or a dedicated division of an existing department) could provide a focussed and streamlined data service. It could ensure that climate change information is distributed to those departments, agencies, local governments, businesses and communities where the information will be most relevant. The entity would be the clear 'go to' authority for current climate change data, modelling and hazard mapping.

Models for providing hazard information

Models for providing and disseminating information sit within a spectrum of other issues that relate to the collection and distribution of information. This discussion focuses on instruments that can be used to provide information about hazards associated with climate change. Such information can come in different forms, including statutory (e.g. planning law) and non-statutory instruments. They can also be categorised according to their scope. Broad information instruments convey general information about hazards, mitigation strategies and/or management options. Narrow information instruments are designed to provide information at a property-scale and directly influence decision-making surrounding its purchase and/or management (e.g. planning certificates provided at the point of sale). Irrespective of the type of information instrument involved, they serve to encourage and support autonomous adaptation and help manage liability risks for government.[1]

Planning certificates under the *Planning and Environment Act 1987* are used to satisfy the requirements of the *Sale of Land Act 1962* which requires vendors to issue a vendor's statement (s

[1] Andrew McIntosh, Anita Foerster and Jan McDonald, *Limp, leap or learn? Developing Legal Frameworks for Climate Change Adaptation Planning in Australia,* National Climate Change Adaptation Research Facility (2013) 74-5.

32 statement) to purchasers before they sign a contract for the sale of land. Following the 2009 Victorian bushfires, amendments were made to these laws to require explicit disclosure of potential bushfire hazard exposure. If land is in a bushfire zone within the meaning of regulations made under the *Building Act 1993*, the vendor's statement must include a specific statement that the land is in such an area.[2]

Such statements are not required for other climate related hazards, for example, in a coastal zone, as there is no standard planning overlay for coastal hazards in Victoria.[3] This project's technical paper *Governance Models for Adaptation: Planning Law and Related Measures* 2014 provides more detail about these issues. The issue of what type of hazard information, in addition to bushfire, should be included in instruments such as s 32 statements warrants further investigation.

Opportunities for government to incorporate hazard information in strategic planning

There are several points within a planning system where hazard mapping and hazard risk assessment can be incorporated into strategic planning.

1. The *Victorian Coastal Strategy 2008* sets out the policy and strategic direction for responding to coastal hazard risks in the context of climate change. A new draft Strategy was released for public comment in September 2013. The Strategy is prepared under the *Coastal Management Act* 1995, which operates in tandem with the principal planning legislation to regulate coastal climate hazards within the planning framework. The Strategy reflects the policy that decision makers should 'apply the precautionary principle to planning and management decision-making when considering the risks associated with climate change'.[4]

2. In March 2014 the Victorian Government released a draft for a new *State Planning Policy Framework*. Draft clause 5 provides guidelines for decision makers concerning flooding and coastal inundation. Under the terms of the current clause 13 and draft clause 5, planning bodies are required to have regard to the Victorian Coastal Strategy. [5] The final version of the new Strategy has not been released but this document offers an opportunity to address:

    - how natural hazards in Victoria can and could be identified;
    - what information about those hazards could be provided, and the manner in which it can be disseminated, and
    - how that information could be addressed in planning decision making processes.

To enable hazard areas to be embedded within municipal planning schemes (e.g. as an overlay) they will need to be comprehensively mapped. Embedding hazard data into spatially-based planning instruments has advantages as it:

[2] Ibid 240.
[3] Ibid 233.
[4] Victorian Coastal Council, *Victorian Coastal Strategy* (2008) 38.
[5] www.dpcd.vic.gov.au/planning/panelsandcommittees/current/state-planning-policy-framework-sppf/draft-planning-policy-framework-master-version.

- provides a clear trigger for development assessment processes;
- ensures that regulatory measures are targeted at, and tailored to, the areas most likely to be affected by the hazards; and
- communicates hazard information to decision makers and the general public, which promotes adaptation.

Challenges associated with the implementation such planning instruments include:

- relating hazard information to development controls;
- the availability of quality downscaled local hazard data; and
- costs associated with the production and dissemination of information.

Hazard information as a driver for adaptation

If information provision encourages greater adaptation efforts by individuals, the costs of providing emergency services may be reduced in the event of a natural disaster. If property owners are informed of the risks they face upon the purchase of a property, claims for government compensation after a natural disaster may be weakened.[6] Similarly, insurance companies can price risk more precisely where they have access to detailed climate risk and natural hazard information.

The need for flexibility to address the uncertainties of climate information does, however, need to be tempered with a need for consistency in decision making. This suggests that there remains a significant role for government to play in establishing policies, guidelines and standards to direct how climate change hazard information is to be incorporated into adaptation decision making processes.

[6] Productivity Commission, *Barriers to Effective Climate Change Adaptation: Productivity Commission Inquiry Report No. 59* (19 September 2012) 140.

Climate Change and Legal Liability : Considerations for Government

This policy brief summarises parts of the research detailed in the technical paper, *Managing the Risks of Climate Change and Natural Hazards: Legal, Information and Insurance Issues* which is available on the VCCCAR website.

Information on climate and hazard risk has emerged as an important driver of adaptation. There remain a number of challenges to the provision of targeted and accessible information on climate risk due to inherent uncertainties. Government provision of information and advice relating to risks associated with adverse climate change effects has the potential to give rise to liability under tort law if it is provided negligently (e.g. it has breached the standards set under negligence laws). Information provision that meets the standards under tort law, generally speaking, will not attract liability.

An expectation that a service will be performed or that information will be provided may, in some circumstances, give rise to a duty of care. Negligence operates on the basis of whether due diligence is exercised in light of the information available at that point in time and provided in good faith. Governments make decisions by balancing and weighting multiple information sources and these factors play a role in determining whether standards have been met.

It is important that the risks of potential liability are set in context against the wider public interest in developing resilient communities and effective responses to hazards given the attendant loss and damage that natural disasters can cause to communities and the financial costs for governments and individuals of dealing with natural hazards.

Government advice can vary from guidance, to which response is voluntary, to codes or standards that may be mandatory to follow. Government provision of climate risk information and its legal consequences is an evolving area which is yet to be fully settled. Whether any specific actions or omissions will give rise to liability requires careful evaluation. The following information should not be regarded as necessarily applying to specific situations.

Potential risks in information provision

The general areas where liability for the Crown and statutory authorities conceivably may arise or alternatively is unlikely to arise is demonstrated by the examples in Table 1. The listing is indicative only and a non- exhaustive list.

Table 1 Potential risks in information transmission

	Planning	Oversight	Operations
Inundation risk	**Floodplain mapping** **Zoning** **Overlays**	• **Permitting** • **Inappropriate planning decisions** • **Conditions on building**	• **Levee construction and maintenance** • **Habitation flood warning** • **Emergency service**

	Planning	Oversight	Operations
		• Inspection • Supervision of agencies	mobilisation • Ingress/egress • Safe havens • Road condition information • Advice on floodwater contamination
Fire	• Building regulation • Vegetation clearing regulations	• Permitting • Conditions on building • Inspection • Emergency services planning and management • Safe haven certification	• Fire condition information • Emergency services information • Evacuation warnings • Road ingress and egress information • Road detour and road closed advice • Safe haven signage • Representations re service delivery
Water quality and availability	• Water quality regulation • Water infrastructure planning and resourcing • Water reticulation service development • Pricing oversight		
Extreme weather events	• Infrastructure planning • Emergency service planning and resourcing	• Infrastructure approval (e.g. levees, dams, channels, storm water drains, road and rail bridge design) • Emergency service agency oversight (e.g. SES, CFA, third	• Infrastructure construction, maintenance and inspection (e.g. bridge inspection, road culvert maintenance, storm water pipe inspection, dam stability inspection) • Emergency service

	Planning	Oversight	Operations
		party contractors) • Emergency communication agency oversight (e.g. 000, GPS operations, mobile phone coverage, emergency app design)	provision (first response agencies, communication with residents, evacuation implementation and advice, road closure information) • Emergency communication operation
Built environment	• Road, bridge and public transport planning • Sewerage and storm water planning	• Road design • Bridge design • Sewerage design • Connections approvals • Third party operations oversight (e.g. storm water harvesting)	• Road maintenance and inspection • Bridge maintenance and inspection • Sewerage maintenance and inspection.
Power outages	• Electricity generation and distribution planning	• Electricity infrastructure design • Oversight private infrastructure operators • Inspection of infrastructure	• Advice on power outages • Communication breakdown • Emergency facility breakdown
Health risks	• Hospital infrastructure and resource planning • Ambulance infrastructure and resource planning • Air pollution regulation • Water pollution regulation	• Building design permitting (air conditioning, air filtration, passive design) • Agency inspection and permitting of private operations • Agency oversight	• Air pollution information promulgation • Water quality information • Ambulance scheduling and availability • Emergency medical availability • Heat risk management in public buildings

	Planning	Oversight	Operations
	• **Building design/ regulation**		

Generally, activities in the first column in Table 1 will not attract a duty of care when carried out by a government instrumentality. They have a policy aspect, and a number of court judgments have held that public authorities could not be liable for damage arising out of a policy decision.[1] However, the scope of matters excluded in this manner is narrow. The activities in the second column could give rise to liability depending on the relationships between the parties and the surrounding circumstances. In this category, liability for oversight of other agencies, such as councils, may also arise. The third column involves matters which could attract liability when carried out (or omitted to be carried out)[2] in a negligent fashion.

Mechanisms for managing liability

Table 2 demonstrates the typical mechanisms for managing liability. Some of these equate to the devices used in the private sector – insurance, contractual disclaimers and scope of service provisions, and some devices are peculiarly available to public sector agencies. Statutory immunities and clear articulation of statutory powers and duties enable those authorities to more effectively manage risk. The technique for risk management, however, depends on the source of the liability. Primary and vicarious liability is more readily identified. Peripheral liability, arising from the failure to control a third party, for instance, or a failure to effectively regulate a third party, is more unpredictable. This type of liability is best managed by clarification of statutory powers and duties, and by management of responsibilities undertaken in service delivery.

Table 2 Examples of Management of liability

	Primary	Vicarious	Peripheral
Prevent duty arising	**'Scope of service' statement (managing expectation and preventing duty arising)**		**Statutory immunity**
	Clarify statutory authority		**No oversight (no**

[1] *Sutherland Shire Council v Heyman* (1985) 157 CLR 424 and *Parramatta City Council v Lutz* (1988) 12 NSWLR 293. Counsel for the State of New South Wales argued this in *Prisoners* (1994) 75 Crim R 205, 212. See Ian Malkin, 'Tort Law's Role in Preventing Prisoners' Exposure to HIV Infection while in Her Majesty's Custody' (1995) 20 *Melbourne University Law Review* 423, 442.

[2] *Ghantous v Hawkesbury City Council* and its companion case *Brodie v Singleton Shire Council* (2001) 206 CLR 512; [2001] HCA 29.

	Primary	Vicarious	Peripheral
	(particularly ensuring that there is no duty to act)		duty undertaken)
	Statutory Immunity		
	No representation of service provision (preventing inadvertent undertaking of duty to act)		
	Privatisation (outsourcing liability)		
	Risk statement (e.g., signage)		Devolution of authority to third party
Proactive Defences	Disclaimer		
Risk management	Insurance	Insurance	Insurance
		Indemnity	Indemnity

Potential liabilities of hazard mapping

Hazard risk mapping has consequences for those relying on the risk maps to make decisions either to do or not to do something. Those decisions may be made by public or private bodies and there may be actions taken on the basis of the mapping that give rise to other risks; for instance, the construction of infrastructure or the management of dams. Another consideration will be whether the decision maker was required to take the maps into account as part of the decision making process.

Table 3, without intending to be exhaustive, illustrates a *range of potential liabilities* and the different outcomes that *could* apply in relation to hazard mapping. It is stressed that these analyses are general and should not be regarded as definitive as the particular facts of each situation need to be taken into account before any liability is determined.

Table 3 Examples of Potential Liabilities and Outcomes

	Risk of damage	Potential action	Potential loss	Potential defendant

	Risk of damage	Potential action	Potential loss	Potential defendant
Mapping incorrectly carried out	Reliance on mapping in construction of public assets which then fail as a result of mapping	Negligence on the basis of the negligent mapping, negligence for failure to oversee the mapping, negligent reliance on the mapping, negligent construction.	Property loss, personal injury or economic loss as a result of the failure of the infrastructure	Authority adopting the mapping, body undertaking risk mapping, authority maintaining assets, construction company.
	Reliance on publicly available mapping in construction of private assets which suffer damage (e.g., house construction)	Negligence (of the mapper, possibly mediated by contract), limited by scope of duty and remoteness principles	Property loss, personal injury or economic loss as a result of the damage to the assets	Authority adopting the mapping, body undertaking risk mapping, construction company.
	Use of mapping to formulate planning rules which result in lowered property values	Potential claims in negligence very close to the policy/operational distinction	Pure economic loss	Local council, state government
	Use of mapping to make planning decisions	Administrative action	Economic loss	Local Council
Mapping incorrectly used	Risk to public infrastructure or to private infrastructure constructed in reliance on mapping	Potential claim in negligence either for the construction or for the information leading to construction of private	Property loss, personal injury or economic loss as a result of the damage to the assets	Authority using the mapping, authority giving mapping advice, construction company.

	Risk of damage	Potential action	Potential loss	Potential defendant
		infrastructure		
Failure to undertake mapping	Risk to private or public infrastructure	Negligence on the basis of failure to use commonly used instruments, negligence for failure to adopt normal risk management, construction of assets without appropriate risk assessment.	Property loss, personal injury or economic loss as a result of the damage to the assets	Authority responsible for construction, authority responsible for overseeing construction, authority giving advice, construction company.

Critical Infrastructure and Climate Change

This policy brief highlights the tools identified in the technical paper *Governance and Legislative Issues for Critical Infrastructure Adaptation to Climate Change* (available on the VCCCAR website) that are available to develop the resilience of critical infrastructure to the impacts of climate change.

The need for resilience

Critical infrastructure interdependencies are significant in the context of adaptation, as they influence resilience. For example, ports rely on other transport modes such as road and rail for the movement of goods and to enable staff access. Cycles of drought followed by flood can damage roads and rail track, slowing or halting the movement of goods in and out of ports. Ports also rely on the availability of electricity to power their own operations and to provide services to visiting vessels. Other port interdependencies include ICT for management of services and drainage infrastructure to prevent flooding. Similar interdependencies exist for all forms of critical infrastructure. There is limited benefit if one operator builds resilience to climate change if its interdependent sectors are not also considering the issues in a collaborative manner.

Roles and responsibilities

As outlined in the *Victorian Adaptation Plan*, the Victorian Government has critical roles and responsibilities to perform to enable adaptation to a changing climate, including managing risks to public sector assets and services managed by the government and supporting private sector adaptation.[1]

While primary responsibility for critical infrastructure resilience resides with infrastructure owners, there is an expectation that government will take appropriate measures to ensure that owners and/or operators manage their risks and that vital service delivery is not interrupted, as recognised in the Victorian government's *Critical Infrastructure Resilience Interim Strategy*.[2]

The challenge is to mainstream adaptation across critical infrastructure sectors so that it is fully integrated into business planning, risk management systems and operational programs.

Regulatory tools

Regulatory tools can include legislation, operation and management plans, codes of practice, standards, contracts and licensing arrangements. These tools are not mutually exclusive and multiple tools may apply simultaneously, depending on the circumstances.
Contracts are a legal mechanism to assign risk between contracting parties. In the context of climate change, risk may be allocated for a range of matters including:

- identifying risk factors for critical infrastructure components,
- undertaking risk assessments,
- preparing and updating adaptation plans, and

[1] Victorian Government, *Victorian Climate Change Adaptation Plan* (March 2013) 10.
[2] Victorian Government, *Critical Infrastructure Resilience Interim Strategy* (December 2013) 1.

- building and maintaining assets to a standard designed to withstand types of extreme weather events.

Risk is costed in contracts. If government enters a contract whereby the contractor is allocated the greatest share of the project risk, the cost to government will be greater than if the government shares the risk equally or bears the greatest burden itself. It is therefore important for government to enter contracts concerning critical infrastructure with a considered understanding of the potential impacts of climate change, so that the risk is allocated, and therefore the costs structured, in a manner commensurate with the scope, scale and climate vulnerabilities of the project.

Government can influence the incorporation of adaptation principles and requirements into a range of tools, including:

- new infrastructure project plans;
- funding agreements;
- output specifications,
- standards;
- asset management plans;
- price review processes for essential services;
- decision making guidance;
- legislation;
- resilience planning.[3]

Opportunities for government to drive critical infrastructure resilience to climate change

1. Model leading risk management practices by embedding climate change considerations into the risk management and business continuity arrangements of publicly owned infrastructure.

2. Mandate the inclusion of adaptation requirements into commercial and contractual arrangements when investing in or procuring new infrastructure projects. For example, incentives may be reflected in the length and terms of contracts/leases and agreements.
3. Fitness for purpose obligations can be incorporated within procurement contracts to stipulate that infrastructure be designed and built to withstand current and future climate change risks.

4. Contracts may incorporate the new standard *Climate Change Adaptation for Settlements and Infrastructure – A Risk Based Approach* as a risk management tool to identify climate change risks for particular infrastructure, and determine appropriate adaptation measures. The standard includes a climate change exposure and infrastructure sensitivity matrix, which includes infrastructure sectors.[4] It provides a framework that can be applied in the context of the commissioning, design, planning, approval, construction, maintenance, management, operation and decommissioning of infrastructure.

[3] HM Government, *The National Adaptation Programme: Making the Country Resilient to a Changing Climate* (July 2013) 38-9.
[4] Standards Australia, *AS 5334-2013 Climate Change Adaptation for Settlements and Infrastructure – A Risk Based Approach* (2013), Tables A1, A2 and A3, 43-8.

5. The *Critical Infrastructure Resilience Interim Strategy*[5] proposes that government departments will custom design assessment methodologies to assess the criticality of Victorian critical infrastructure in their sector. The methodology will consider all hazards and a range of risks consistent with AS/NZS ISO31000 *Risk Management-Principles and Guidelines*. The development of these methodologies provides an opportunity to ensure that climate change is considered within the 'all hazard' risk framework.

6. Provide climate risk information to the private sector to help drive adaptation measures, as recognised in the *Victorian Adaptation Plan*.[6] In 2012 the Victorian government issued new Victorian Coastal Inundation Maps and Dataset to provide information for the whole of the state's coastline on the potential for flooding from sea level rise and storm tides.[7] Private organisations need data to make decisions about the risks that climate change may pose to their businesses. The specific risks need to be identified so that appropriate adaptation strategies can be developed.

7. Critical infrastructure operators need to work with the operators of other key infrastructure sectors to ensure there is a co-ordinated approach to climate change adaptation. There are existing critical infrastructure Security and Continuity Networks (SCNs) and the Trusted Information Sharing Network (TISN), auspiced by the Victorian government. These types of networks provide opportunities for infrastructure operators to engage with government on issues concerning climate change, to facilitate support for adaptation measures.

[5] Victorian Government, *Critical Infrastructure Resilience Interim Strategy* (December 2013).
[6] Victorian Government, *Victorian Climate Change Adaptation Plan* (March 2013) 32.
[7] Ibid 51.

Engaging Ports in Climate Change Adaptation

This policy brief summarises the main take out messages from the research detailed in the technical paper *Governance and Legislative Issues for Critical Infrastructure Adaptation to Climate Change* which is available on the VCCCAR website.

Public and private roles

The *Victorian Climate Change Adaptation Plan* (the *Victorian Adaptation Plan*) [1] places responsibility on private sector entities to manage risks to their private assets and activities, on the basis they are best placed to do so.[2] However, it recognizes that interruptions to activities at ports have 'significant flow-on implications across the state with operations compromised by delays in moving goods which impacts businesses and communities'.[3] To the extent that port functions can therefore be identified as providing a public good, there is a role for government to play, as private entities are not exposed to the full costs to society of infrastructure failure – for example, cascading costs incurred by the freight and logistics sectors if ports are not fully operational for a period of time due to extreme weather.

The mix of commercial government owned ports (Melbourne and Hastings) and privately owned ports (Portland and Geelong) in Victoria presents challenges as they operate under governance and legislative regimes which, whilst there are some commonalities, also have points of difference. Privately owned ports have a commercial focus while government owned ports have a broader public focus. The focus on returning a profit to shareholders will become predominant as the trend to privatise critical infrastructure continues. The technical paper compares their different governance arrangements and assesses whether these facilitate, impede, or are silent about climate change adaptation strategies.

Legislative framework

There are two overarching pieces of legislation that regulate ports in Victoria - the *Port Management Act 1995* (the PMA) and the *Transport Integration Act 2010* (the TIA).

The Port of Melbourne Corporation (PoMC) and the Port of Hastings Development Authority (PoHDA), which are statutory authorities responsible for their respective ports, are 'transport bodies' for the purposes of the TIA.[4] In that capacity are required to have regard to the transport system objectives set out in the TIA when exercising their powers and performing their functions under any transport legislation.[5] The most relevant are 'economic prosperity',[6] 'environmental sustainability',[7]and 'efficiency, coordination and reliability'.[8] 'Environmental sustainability' includes preparing for and adapting to the challenges presented by climate change.[9]

[1] Victorian Government, *Victorian Climate Change Adaptation Plan* (March 2013).
[2] Ibid 11.
[3] Ibid 18.
[4] TIA, s3.
[5] TIA, s24.
[6] TIA, s9.
[7] TIA, s10.

The objectives reflect a whole-of-government perspective and are relevant to the commercial ports as they constitute crucial components of Victoria's freight networks. However, the privately owned and operated commercial ports at Portland and Geelong are not required to have regard to the TIA objectives. This means they can operate in a manner to maximise their economic performance, without consideration of the factors embodied in the objectives.

Safety and Emergency Management Plans

The PMA requires commercial and local port managers to prepare Safety and Emergency Management Plans (SEMPs) for the whole of the port area which the manager controls or manages.[10] SEMPs must be prepared in accordance with Ministerial Guidelines.[11]SEMPs must identify the area or areas of port lands and waters to which they apply. The description must highlight any key facilities and infrastructure in the port that are vulnerable to extreme climate events.[12]

The Guidelines require port managers to undertake a comprehensive hazard and risk identification process that identifies the nature and extent of hazards and risks within the port area, including the hazards and risks that could result in an emergency that may be of high consequence.[13]

The Guidelines note that port managers are expected to take reasonable steps to engage with, and influence, within the bounds of their legal and commercial powers, tenants, licensees and service providers to ensure that operations in areas of the port for which those parties have primary control are covered by SEMPs.[14]'Reasonable steps' may include the incorporation of SEMP related requirements into current/new tenancy agreements, 'common user agreements', licences and other relevant commercial/access agreements.[15]

Options to drive incorporation of climate change issues in port environments

1. Legislation can enable assessment of climate change risks and the development of adaptation strategies, either explicitly, or by being broad enough to encompass consideration of climate change issues. The Victorian *Terrorism (Community Protection) Act 2003* is an example of legislation that focuses on a single risk factor – terrorism – and could be used as a model to require owners of ports and other critical infrastructure to include assessments of climate change risks in their general risk profiles, and require adaptation plans to be developed following the assessments.

---

[8] TIA, s12.
[9] TIA, s10(e).
[10] PMA, s91C.
[11] PMA, s91D(3).
[12] Victorian Government, *Ministerial Guidelines: Port Safety and Environment Management Plans,* November 2012, 14.
[13] Ibid 14.
[14] Ibid 21.
[15] Ibid 22.

2. The *Climate Change Act 2010* requires decisions made under certain scheduled Acts to 'have regard to the potential impacts of climate change'[16] but neither the TIA nor the PMA are scheduled Acts. As the overarching climate change legislation in Victoria, it may be desirable to expand the list of scheduled Acts to require the transport sector to consider climate change impacts.

3. The PMA requires commercial ports to prepare a Port Development Strategy (PDS) at four yearly intervals.[17] The PDSs could be required to encompass climate change adaptation pathways.

4. The PoMC and the PoHDA are required to perform their functions consistently with State policies and strategies for the development of Victorian ports and freight networks.[18] Overarching government policies setting out the future directions for ports could include specific requirements about the resilience of port infrastructure and assets in the face of extreme climate events.

5. Ports need to work with the operators of other key infrastructure sectors to ensure there is a co-ordinated approach to climate change adaptation. There are existing critical infrastructure Security and Continuity Networks (SCNs) and the Trusted Information Sharing Network (TISN), auspiced by the Victorian government. The PoMC and Port of Geelong are members of the SCN for Roads, Ports and Freight. These types of networks provide opportunities for infrastructure operators to engage with government on issues concerning climate change, to facilitate support for adaptation measures.

6. The port maintenance requirements in contractual documents need to be very specific, while not encouraging 'gold-plating' maintenance standards which will increase charges imposed by ports on their customers with no demonstrated value in return.

7. SEMPs could be a strong tool to facilitate climate change adaptation as they are a legally-mandated instrument that require an integrated and coordinated plan across the whole of a port area. SEMPs are a high level document but the focus on coordination cascades down into documents and plans of operators and tenants in a port. For example, Port User Operating licences are a tool that can be used to encourage environmental awareness and responsibility for personnel operating on port land.

8. The discussion in the Ministerial Guidelines about hazard and risk identification can, and should, be interpreted to include climate risks in port areas.

9. Operation and management plans can be required to incorporate climate change issues. As an example, the 2012 Ministerial Guidelines for the SEMP scheme require port managers to identify

[16] *Climate Change Act 2010* (Vic), s 14.
[17] PMA, s 91K.
[18] TIA, ss141E(2)(a) and 141T(2) respectively.

facilities and infrastructure in the port that are vulnerable to extreme climate events. These Guidelines could be strengthened to require port managers to also outline adaptation measures to be taken to address those vulnerabilities and risks.

Adaptability to climate change is an important factor to be considered in current and future port expansion and development projects. If it is not embedded into ports' business, operational and risk management frameworks, the risk is that extreme weather may threaten the ability of ports to operate at their optimum level. They may be exposed to short and/or medium term shut-downs to deal with damaged infrastructure and roads, with cascading impacts on freight and logistics networks.